



**BMS COLLEGE OF ENGINEERING, BANGALORE-19**  
(Autonomous College under VTU Belagavi)  
**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**



**ಬಿ. ಎಂ. ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ**  
(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

**B.M.S. COLLEGE OF ENGINEERING, BANGALORE - 19**  
(Autonomous College under VTU)

**Department of Computer Science and Engineering**

**Scheme and Syllabus for**  
**III to VIII Semester**  
**2024-2028 Batch**

**ಬಿ. ಎಂ. ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ**  
ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು - 560 019

**B.M.S. COLLEGE OF ENGINEERING, BANGALORE - 19**  
Bull Temple Road, Bangalore - 560 019



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## **VISION OF INSTITUTE**

Promoting Prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

## **MISSION OF INSTITUTE**

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society.

## **DEPARTMENT VISION & MISSION**

### **VISION**

To be a model centre for education and training in the frontier areas of Computer Science and Engineering.

### **MISSION**

- To Educate and Empower the students in the area of Computer Science by providing best practices of Teaching Learning Process for successful professional career.
- To enhance skills of the students to pursue higher studies and research.
- To foster the students to innovate and nurture them towards Entrepreneurship.



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**COURSE TYPES:**

|                                                   |      |
|---------------------------------------------------|------|
| Basic Science Course                              | BS   |
| Engineering Science Course                        | ES   |
| Professional Core Course                          | PC   |
| Professional Elective Course                      | PE   |
| Group Core                                        | GC   |
| Cluster Core                                      | CC   |
| Open Elective Course                              | OE   |
| Project / Mini-Project                            | PW   |
| Seminar–Internship                                | SR   |
| Humanities and Social Sciences, Management Course | HS   |
| Non-Credit Mandatory Course                       | NCMC |



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| Curricular Component/ Semester                         | I  | II | III | IV | V  | VI | VII | VIII | Total Credits |
|--------------------------------------------------------|----|----|-----|----|----|----|-----|------|---------------|
| Basic Science Course (BS)                              | 8  | 8  | 3   | 3  | 1  | -- | --  | --   | 23            |
| Engineering Science Course (ES)                        | 9  | 9  | 3   | 3  | -- | -- | --  | --   | 24            |
| Professional Core Course (PC)                          | -- | -- | 15  | 14 | 14 | 11 | 6   | --   | 60            |
| Professional Elective Course (PE)                      | -- | -- | --  | -- | 3  | 3  | 3   | 3    | 12            |
| Open Elective Course (OE)                              | -- | -- | --  | -- | -- | 3  | 3   | 3    | 9             |
| Project/ Mini-Project (PW)                             | -- | -- | --  | -- | 2  | 2  | 8   | --   | 12            |
| Internship (Re/Ru/In)                                  | -- | -- | --  | -- | -- | -- | --  | 6    | 6             |
| Humanities and Social Sciences, Management Course (HS) | 1  | 1  | --  | -- | 1  | -- | --  | --   | 3             |
| Ability Enhancement Course /SDC                        | 2  | 2  | 1   | 1  | 1  | 3  | --  | --   | 10            |
| UHV Courses(AE)                                        | -- | -- | --  | 1  | -- | -- | --  | --   | 1             |
| Non-Credit Mandatory Course                            | -- | -- | NC  | NC | NC | NC | --  | --   | --            |
| Total Credits                                          | 20 | 20 | 22  | 22 | 22 | 22 | 20  | 12   | 160           |



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**Semester-III**

| No.   | Course Type | Code       | Course Title                           | Credits |   |   | Total Credits | Total Hours |
|-------|-------------|------------|----------------------------------------|---------|---|---|---------------|-------------|
|       |             |            |                                        | L       | T | P |               |             |
| 1     | BS          | 23MA3BSSDM | Statistics and Discrete Mathematics    | 2       | 1 | 0 | 3             | 4           |
| 2     | ES          | 23CS3ESCOA | Computer Organization and Architecture | 3       | 0 | 0 | 3             | 3           |
| 3     | PC-1        | 23CS3PCOOJ | Object Oriented Java Programming       | 3       | 0 | 1 | 4             | 5           |
| 4     | PC-2        | 23CS3PCLOD | Logic Design                           | 2       | 0 | 0 | 2             | 2           |
| 5     | PC-3        | 23CS3PCDBM | Database Management Systems            | 3       | 0 | 1 | 4             | 5           |
| 6     | PC-4        | 23CS3PCDST | Data Structures                        | 3       | 0 | 1 | 4             | 5           |
| 7     | PC-5        | 23CS3PCUSP | Unix Shell Programming                 | 0       | 1 | 0 | 1             | 2           |
| 8     | AE/SDC      | 23CS3AEFWD | Full Stack Web development             | 0       | 0 | 1 | 1             | 2           |
|       |             | 23CS3AETEW | Technical Writing                      |         |   |   |               |             |
|       |             | 23CS3AEASL | Assembly Language                      |         |   |   |               |             |
| 9     | NCMC        | 23NCMC3NS1 | NSS-1                                  | 0       | 0 | 0 | 0             | 0           |
|       |             | 23NCMC3YG1 | YOGA-1                                 |         |   |   |               |             |
|       |             | 23NCMC3PE1 | Physical Education-1                   |         |   |   |               |             |
|       |             | 24NCMC3IM1 | Indian Music-1                         |         |   |   |               |             |
|       |             | 24NCMC3WM1 | Western Music -1                       |         |   |   |               |             |
|       |             | 24NCMC3TA1 | Theatre Arts -1                        |         |   |   |               |             |
|       |             | 24NCMC3FA1 | Fine Arts -1                           |         |   |   |               |             |
|       |             | 24NCMC3MM1 | Multimedia - 1                         |         |   |   |               |             |
|       |             | 24NCMC3ID1 | Indian Dance-1                         |         |   |   |               |             |
|       |             | 24NCMC3WD1 | Western Dance-1                        |         |   |   |               |             |
| TOTAL |             |            |                                        | 16      | 2 | 4 | 22            | 28          |



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**Semester-IV**

| No.   | Course Type | Code       | Course Title                            | Credits |   |   | Total Credits | Total Hours |
|-------|-------------|------------|-----------------------------------------|---------|---|---|---------------|-------------|
|       |             |            |                                         | L       | T | P |               |             |
| 1     | BS          | 23MA4BSLAO | Linear Algebra and Optimization         | 2       | 1 | 0 | 3             | 4           |
| 2     | ES          | 23CS4ESCRP | Cryptography                            | 3       | 0 | 0 | 3             | 3           |
| 3     | PC          | 23CS4PCTFC | Theoretical Foundations of Computations | 2       | 1 | 0 | 3             | 4           |
| 4     | PC          | 23CS4PCOPS | Operating Systems                       | 3       | 0 | 1 | 4             | 5           |
| 5     | PC          | 23CS4PCADA | Analysis and Design of Algorithms       | 3       | 0 | 1 | 4             | 5           |
| 6     | PC          | 23CS4PCSED | Software Engineering                    | 3       | 0 | 0 | 3             | 3           |
| 7     | UHV         | 22MA4AEUHV | Universal Human Values                  | 0       | 1 | 0 | 1             | 2           |
| 8     | AE          | 23CS4AEMAD | Mobile Application Development          | 0       | 0 | 1 | 1             | 2           |
|       |             | 23CS4AEUIX | UI/UX Design                            |         |   |   |               |             |
|       |             | 23CS4AEHID | Hardware interface design               |         |   |   |               |             |
| 9     | NCMC        | 23NCMC3NS2 | NSS-2                                   | 0       | 0 | 0 | 0             | 0           |
|       |             | 23NCMC3YG2 | YOGA-2                                  |         |   |   |               |             |
|       |             | 23NCMC3PE2 | Physical Education-2                    |         |   |   |               |             |
|       |             | 24NCMC3IM2 | Indian Music-2                          |         |   |   |               |             |
|       |             | 24NCMC3WM2 | Western Music -2                        |         |   |   |               |             |
|       |             | 24NCMC3TA2 | Theatre Arts -2                         |         |   |   |               |             |
|       |             | 24NCMC3FA2 | Fine Arts -2                            |         |   |   |               |             |
|       |             | 24NCMC3MM2 | Multimedia - 2                          |         |   |   |               |             |
|       |             | 24NCMC3ID2 | Indian Dance-2                          |         |   |   |               |             |
|       |             | 24NCMC3WD2 | Western Dance-2                         |         |   |   |               |             |
| TOTAL |             |            |                                         | 16      | 3 | 3 | 22            | 28          |



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**Semester- V**

| No.   | Course Type | Code       |     | Course Title                                    | Credits |   |   | Total Credits | Total Hours |
|-------|-------------|------------|-----|-------------------------------------------------|---------|---|---|---------------|-------------|
|       |             |            |     |                                                 | L       | T | P |               |             |
| 1     | PC          | 23CS5PCOOM |     | Object Oriented Modelling                       | 2       | 0 | 1 | 3             | 4           |
| 2     | PC          | 23CS5PCDEV |     | Data Exploration and Visualization              | 2       | 1 | 0 | 3             | 4           |
| 3     | PC          | 23CS5PCAIN |     | Artificial Intelligence                         | 3       | 0 | 1 | 4             | 5           |
| 4     | PC          | 25CS5PCCON |     | Computer Networks                               | 3       | 0 | 1 | 4             | 5           |
| 5     | HS          | 23CV5HSEVS |     | Environmental Studies                           | 1       | 0 | 0 | 1             | 1           |
| 6     | BS          | 23CS5BSBIS |     | Bio Inspired Systems                            | 0       | 0 | 1 | 1             | 2           |
| 7     | PE          | 23CS5PEXXX | RPA | Robot Process Automation Design and Development | 3       | 0 | 0 | 3             | 3           |
|       |             |            | CPD | Compiler Design                                 |         |   |   |               |             |
|       |             |            | CGH | Computer Graphics                               |         |   |   |               |             |
|       |             |            | AAM | Advanced Algorithms                             |         |   |   |               |             |
|       |             | 25CS5PEPSI |     | Product, Services and IT Service Management     |         |   |   |               |             |
| 8     | AE          | 23CS5AEAST |     | Automated Software Testing                      | 0       | 0 | 1 | 1             | 2           |
|       |             | 23CS5AECCO |     | Competitive Coding                              |         |   |   |               |             |
|       |             | 23CS5AEDOP |     | DevOps -Tools                                   |         |   |   |               |             |
| 9     | PW          | 23CS5PWMIP |     | Mini Project                                    | 0       | 0 | 2 | 2             | 4           |
| 10    | NCMC        | 23NCMC5NS3 |     | NSS-3                                           | 0       | 0 | 0 | 0             | 0           |
|       |             | 23NCMC5YG3 |     | YOGA-3                                          |         |   |   |               |             |
|       |             | 23NCMC5PE3 |     | Physical Education-3                            |         |   |   |               |             |
|       |             | 24NCMC5IM3 |     | Indian Music-3                                  |         |   |   |               |             |
|       |             | 24NCMC5WM3 |     | Western Music -3                                |         |   |   |               |             |
|       |             | 24NCMC5TA3 |     | Theatre Arts -3                                 |         |   |   |               |             |
|       |             | 24NCMC5FA3 |     | Fine Arts -3                                    |         |   |   |               |             |
|       |             | 24NCMC5MM3 |     | Multimedia - 3                                  |         |   |   |               |             |
|       |             | 24NCMC5ID3 |     | Indian Dance-3                                  |         |   |   |               |             |
|       |             | 24NCMC5WD3 |     | Western Dance-3                                 |         |   |   |               |             |
|       |             |            |     | Details of 40 AICTE Activity Points             |         |   |   |               |             |
| TOTAL |             |            |     |                                                 | 14      | 1 | 7 | 22            | 30          |



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**Semester-VI**

| No.   | Course Type | Code                                  |     | Course Title                               | Credits |   |   | Total Credits | Total Hours |
|-------|-------------|---------------------------------------|-----|--------------------------------------------|---------|---|---|---------------|-------------|
|       |             |                                       |     |                                            | L       | T | P |               |             |
| 1     | PC          | 23CS6PCCCT                            |     | Cloud Computing                            | 2       | 1 | 0 | 3             | 4           |
| 2     | PC          | 23CS6PCBDA                            |     | Big Data Analytics                         | 3       | 0 | 1 | 4             | 5           |
| 3     | PC          | 23CS6PCMAL                            |     | Machine Learning                           | 3       | 0 | 1 | 4             | 5           |
| 4     | AE          | 23CS6AERMI<br>*MOOC/<br>NPTEL Courses |     | Research Methodology and IPR               | 3       | 0 | 0 | 3             | 3           |
| 5     | PE          | 23CS6PE<br>XXX                        | ACN | Advanced Computer Networks                 | 3       | 0 | 0 | 3             | 3           |
|       |             |                                       | BLC | Blockchain Technology                      |         |   |   |               |             |
|       |             |                                       | CVI | Computer Vision and Image Processing       |         |   |   |               |             |
|       |             |                                       | ADS | Advanced Data Structures                   |         |   |   |               |             |
| 6     | OE(MOOC)    | 25MC6OE<br>XXX                        | CS1 | Cloud Computing                            | 3       | 0 | 0 | 3             | 3           |
| 7     | PW-1        | 23CS6PWPP1                            |     | Major Project Phase-1                      | 0       | 0 | 2 | 2             | 4           |
| 8     | NCMC        | 23NCMC6NS4                            |     | NSS-4                                      | 0       | 0 | 0 | 0             | 0           |
|       |             | 23NCMC6YG4                            |     | YOGA-4                                     |         |   |   |               |             |
|       |             | 23NCMC6PE4                            |     | Physical Education-4                       |         |   |   |               |             |
|       |             | 24NCMC6IM4                            |     | Indian Music-4                             |         |   |   |               |             |
|       |             | 24NCMC6WM4                            |     | Western Music -4                           |         |   |   |               |             |
|       |             | 24NCMC6TA4                            |     | Theatre Arts -4                            |         |   |   |               |             |
|       |             | 24NCMC6FA4                            |     | Fine Arts -4                               |         |   |   |               |             |
|       |             | 24NCMC6MM4                            |     | Multimedia - 4                             |         |   |   |               |             |
|       |             | 24NCMC6ID4                            |     | Indian Dance-4                             |         |   |   |               |             |
|       |             | 24NCMC6WD4                            |     | Western Dance-4                            |         |   |   |               |             |
|       |             |                                       |     | Details of 60 AICTE Activity Points Earned |         |   |   |               |             |
| TOTAL |             |                                       |     |                                            | 17      | 1 | 4 | 22            | 27          |



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**Semester-VII**

| No.   | Course Type | Code                                      |     | Course Title                               | Credits |   |   | Total Credits | Total Hours |
|-------|-------------|-------------------------------------------|-----|--------------------------------------------|---------|---|---|---------------|-------------|
|       |             |                                           |     |                                            | L       | T | P |               |             |
| 1     | PC          | 23CS7PCNWP                                |     | Network Programming                        | 2       | 1 | 0 | 3             | 3           |
| 2     | PC          | 23CS7PCMNE                                |     | Management and Entrepreneurship            | 3       | 0 | 0 | 3             | 3           |
| 3     | PE          | 23CS7PEXXX /<br>23CS8PEXXX                | SWA | Software Architecture                      | 3       | 0 | 0 | 3             | 3           |
|       |             |                                           | SCN | Soft Computing                             |         |   |   |               |             |
|       |             |                                           | NLP | Natural Language Processing                |         |   |   |               |             |
|       |             |                                           | WMC | Wireless and Mobile Communication          |         |   |   |               |             |
|       |             | 25CS7PENP1/25CS8PENP1                     |     | NPTEL Course-1*                            |         |   |   |               |             |
| 4     | OE(MOOC)    | 25MC7OEXXX<br><br>*MOOC/<br>NPTEL Courses |     | Open Elective/<br>MOOC course              | 3       | 0 | 0 | 3             | 3           |
| 5     | PW          | 23CS7PWPP2                                |     | Major Project Phase-2                      | 0       | 0 | 7 | 7             | 14          |
| 6     | HS          | 25MA7HSIKL                                |     | Indian Knowledge Systems                   | 1       | 0 | 0 | 1             | 1           |
|       |             |                                           |     | Details of 80 AICTE Activity Points Earned |         |   |   |               |             |
| TOTAL |             |                                           |     |                                            | 12      | 1 | 7 | 20            | 27          |



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**Semester-VIII**

| No.   | Course Type | Code                                      |     | Course Title                                      | Credits |   |   | Total Credits | Total Hours |
|-------|-------------|-------------------------------------------|-----|---------------------------------------------------|---------|---|---|---------------|-------------|
|       |             |                                           |     |                                                   | L       | T | P |               |             |
| 1     | PE          | 23CS8PEXXX/<br>23CS7PEXXX                 | NES | Network Security                                  | 3       | 0 | 0 | 3             | 3           |
|       |             |                                           | NDL | Neural network and Deep Learning                  |         |   |   |               |             |
|       |             |                                           | VAR | Virtual & Augmented Reality                       |         |   |   |               |             |
|       |             |                                           | HPC | High Performance Computing                        |         |   |   |               |             |
|       |             | 25CS8PENP2/<br>25CS7PENP2                 |     | NPTEL Course-2*                                   |         |   |   |               |             |
| 2     | OE(MOOC)    | 25MC8OEXXX<br><br>*MOOC/<br>NPTEL Courses |     | Open Elective/<br>MOOC course                     | 3       | 0 | 0 | 3             | 3           |
| 3     | INT         | 23CS8SRINT                                |     | Internship                                        | 0       | 0 | 6 | 6             | 12          |
|       |             |                                           |     | Details of 100<br>AICTE Activity<br>Points Earned |         |   |   |               |             |
| TOTAL |             |                                           |     |                                                   | 6       | 0 | 6 | 12            | 18          |



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# **3<sup>rd</sup>**

# **Semester**



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|                      |                                            |                       |          |
|----------------------|--------------------------------------------|-----------------------|----------|
| <b>Semester:</b>     | <b>3</b>                                   |                       |          |
| <b>Course Title:</b> | <b>Statistics and Discrete Mathematics</b> |                       |          |
| <b>Course Code:</b>  | <b>23MA3BSSDM</b>                          |                       |          |
| <b>L-T-P:</b>        | <b>2-1-0</b>                               | <b>Total Credits:</b> | <b>3</b> |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                      | <b>Hours</b> |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1               | <b>GRAPH THEORY: Basic Concepts:</b> Types of graphs, order and size of a graph, in-degree and out-degree, connected and disconnected graphs, Eulerian graphs, Hamiltonian graphs, sub-graphs, and Isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix. Trees: spanning tree, minimal spanning tree: Kruskal's algorithm and shortest path-Dijkstra's algorithm | 8            |
| 2               | <b>Probability Distributions: Theoretical distributions: Discrete and continuous random variables:</b> Discrete distributions, Poisson distribution, Geometric distributions. Continuous distributions: Exponential, Gaussian, Uniform Distribution and Gamma distributions.                                                                                                                       | 8            |
| 3               | <b>Joint Probability And Markov Chain:</b> Joint Probability Distributions: Discrete and continuous joint random variables, Mathematical expectations, Covariance, and Correlation.<br>Markov Chain: Probability vector, stochastic matrix, fixed point vector, regular stochastic matrix. Higher transition probabilities, stationary distribution of regular Markov chain.                       | 8            |
| 4               | <b>Statistical Inference:</b> Introduction, procedure for testing of hypothesis, level of significance.<br>Large sample: Test of significance for single mean and difference between two means.<br>Small sample: Test of significance for single mean, the difference between two means, paired t-test, ratio of variances (F-distribution) and Chi-Square goodness of fit.                        | 8            |
| 5               | <b>Combinatorics:</b> Introduction, Binomial and multinomial theorems, Catalan numbers, the principle of inclusion and exclusion, Derangements, Rook Polynomials.                                                                                                                                                                                                                                  | 7            |

**Prescribed Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>              | <b>Authors</b>          | <b>Edition</b>  | <b>Publisher</b>                   | <b>Year</b> |
|----------------|--------------------------------|-------------------------|-----------------|------------------------------------|-------------|
| 1              | Graph Theory and Combinatorics | D. S. Chandrasekharaiah | 4 <sup>th</sup> | Prism Engineering Education Series | 2011-12     |
| 2              | Higher Engineering             | B. V. Ramana            |                 | Tata McGraw Hill                   | 2007        |



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|   |                                           |                  |                 |                        |  |
|---|-------------------------------------------|------------------|-----------------|------------------------|--|
|   | Mathematics                               |                  |                 |                        |  |
| 3 | Discrete Mathematics and its applications | Kenneth H. Rosen | 7 <sup>th</sup> | McGraw Hill Publishers |  |

**Reference Text Book:**

| Sl. No. | Book Title                                                         | Authors                                               | Edition         | Publisher                  | Year |
|---------|--------------------------------------------------------------------|-------------------------------------------------------|-----------------|----------------------------|------|
| 1       | Discrete Mathematics                                               | Kolman, Busby Ross                                    | 5 <sup>th</sup> | Prentice Hall              | 2004 |
| 2       | Graph Theory with Applications to Engineering and Computer Science | Narsingh Deo                                          | Eastern Economy | PHI Learning Pvt., Ltd     |      |
| 3       | Mathematics for Machine Learning                                   | Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong |                 | Cambridge University Press | 2020 |

**E-books and online course materials:**

1. <http://jlmartin.faculty.ku.edu/~jlmartin/courses/math725-S16/>
2. [https://www.whitman.edu/mathematics/cgt\\_online/cgt.pdf](https://www.whitman.edu/mathematics/cgt_online/cgt.pdf)

**Online Courses and Video Lectures:**

1. <https://www.coursera.org/learn/probability-intro>
2. [https://nptel.ac.in/courses/111104026/\(DiscreteMathematics\)](https://nptel.ac.in/courses/111104026/(DiscreteMathematics))
3. [https://nptel.ac.in/courses/111106086/\(Combinatorics\)](https://nptel.ac.in/courses/111106086/(Combinatorics))

**Course Outcomes (COs):**

|            |                                                                                                      |
|------------|------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concept of Discrete Mathematics and Statistics in Computer and Allied Engineering Science. |
| <b>CO2</b> | Demonstrate the Importance of Discrete Mathematics and Statistics using Modern IT Tools.             |

**CO-PO-PSO mapping:**

|            | PO1      | PO2 | PO3 | PO4 | PO5      | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|----------|-----|-----|-----|----------|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | <b>3</b> |     |     |     |          |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> | <b>3</b> |     |     |     | <b>3</b> |     |     |     |     |      |      |      |      |      |



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**Assessment Plan for CIE:**

| <b>Tool</b>  | <b>Remarks</b> | <b>Marks</b> |
|--------------|----------------|--------------|
| Quiz         | 10             | 5            |
| AAT          | 10             | 5            |
| Test 1       | 40             | 20           |
| Test 2       | 40             | 20           |
| <b>Total</b> |                | <b>50</b>    |



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|                      |                                               |                             |           |
|----------------------|-----------------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>3</b>                                      |                             |           |
| <b>Course Title:</b> | <b>Computer Organization and Architecture</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS3ESCOA</b>                             | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                                  | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Hours</b> |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Basic Structure of Computers Instruction Set Architecture:</b><br>Functional Units, Basic Operational Concepts, Number Representation and Arithmetic Operations, Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes                                                                                                                                                                                               | <b>8</b>     |
| <b>2</b>        | <b>Introduction to Assembly Language:</b><br>Concepts, Stacks, Subroutines, Additional Instructions, Basic Input/Output: Accessing I/O Devices, Interrupts, Bus Structure, Bus Operation, Arbitration                                                                                                                                                                                                                                                                          | <b>8</b>     |
| <b>3</b>        | <b>Memory System:</b><br>Basic Concepts, Semiconductor RAM Memories, Read-only Memories, Direct Memory Access, Memory Hierarchy, Cache Memories: Mapping Functions, Virtual Memory                                                                                                                                                                                                                                                                                             | <b>9</b>     |
| <b>4</b>        | <b>Arithmetic:</b><br>Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Unsigned Numbers, Multiplication of Signed Numbers<br>Fast Multiplication: Bit-Pair Recoding of Multipliers, Carry-Save Addition of Summands, Summand Addition Tree using 3-2 Reducers, Integer Division, Floating Point Numbers and Operations: Arithmetic Operations on Floating-Point Numbers, Guard Bits and Truncation, Implementing Floating-Point Operations | <b>9</b>     |
| <b>5</b>        | <b>Basic Processing Unit:</b><br>Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Hardwired Control.<br><br><b>Parallel Processing and Performance:</b><br>Hardware Multithreading, Vector Processing, Shared memory Multiprocessors, Cache Coherence, Message Passing Multicomputer                                                                                                                              | <b>8</b>     |



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**Prescribed Text Book:**

| Sl. No. | Book Title                                 | Authors                                                       | Edition         | Publisher        | Year |
|---------|--------------------------------------------|---------------------------------------------------------------|-----------------|------------------|------|
| 1       | Computer Organization and Embedded Systems | Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian | 6 <sup>th</sup> | Tata McGraw Hill | 2012 |

**Reference Text Books:**

| Sl. No. | Book Title                                                       | Authors                              | Edition          | Publisher | Year |
|---------|------------------------------------------------------------------|--------------------------------------|------------------|-----------|------|
| 1       | Computer Organization and Design-The Hardware/Software Interface | David A. Patterson, John L. Hennessy | 5 <sup>th</sup>  | Elsevier  | 2013 |
| 2       | Computer Organization & Architecture                             | William Stallings                    | 11 <sup>th</sup> | Pearson   | 2018 |

**E-Book:**

| Sl. No. | Book Title                                                          | Authors                              | Edition         | Publisher | Year | URL                                                                                                                                                                                                                                                     |
|---------|---------------------------------------------------------------------|--------------------------------------|-----------------|-----------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Computer Organization and Design: The Hardware / Software Interface | David A. Patterson, John L. Hennessy | 4 <sup>th</sup> | Elsevier  | 2012 | <a href="https://books.google.co.in/books?id=U6lpXmu7OngC&amp;printsec=frontcover&amp;redir_esc=y#v=onepage&amp;q&amp;f=false">https://books.google.co.in/books?id=U6lpXmu7OngC&amp;printsec=frontcover&amp;redir_esc=y#v=onepage&amp;q&amp;f=false</a> |

**MOOC Course:**

| Sl. No. | Course name                            | Course Offered By | Year | URL                                                                                                                     |
|---------|----------------------------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------------|
| 1.      | Computer Architecture and Organization | NPTEL             | 2021 | <a href="https://onlinecourses.nptel.ac.in/noc21_cs61/preview">https://onlinecourses.nptel.ac.in/noc21_cs61/preview</a> |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Course Outcomes (COs):**

|            |                                                                                                            |
|------------|------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concepts of basic functional units to demonstrate the working of computational system.           |
| <b>CO2</b> | Analyse the issues of the processor architecture to improve the efficiency in computer design.             |
| <b>CO3</b> | Design memory modules and Arithmetic Logic unit for a given specification by analysing performance issues. |

**CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |     | 2   |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> |     |     | 2   |     |     |     |     | 2   | 2   |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                 | Remarks            | Marks      |
|----------------------|--------------------|------------|
| <b>Internals</b>     | <b>Best 2 of 3</b> | <b>40</b>  |
| <b>Quiz</b>          | <b>ONE</b>         | <b>05</b>  |
| <b>Lab Component</b> | <b>---</b>         | <b>---</b> |
| <b>Assignment</b>    | <b>ONE</b>         | <b>05</b>  |
| <b>Total</b>         |                    | <b>50</b>  |

**Rubrics used for AAT evaluation:**

| Criteria                                                                        | Exemplary                                                                        | Proficient                                                           | Partially Proficient                                                             | Points        |
|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------------|---------------|
| <b>Designing the Memory Organization</b>                                        | <b>(4-5)</b><br>A memory organization is designed with appropriate configuration | <b>(2-3)</b><br>A memory organization is designed with configuration | <b>(0-1)</b><br>A memory organization is designed without concern to complexity. | <b>__ / 5</b> |
| <b>Application of Mapping Techniques (Direct, Associative, Set-Associative)</b> | <b>(4-5)</b><br>Correct and detailed explanation and/or implementation           | <b>(2-3)</b><br>Applies mapping concepts with minor mistakes.        | <b>(0-1)</b><br>Limited application; lacks clarity                               | <b>__/5</b>   |



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|                                    |                                                                                    |                                                                                                                              |                                                                                                           |        |
|------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|--------|
|                                    | of mapping techniques                                                              |                                                                                                                              |                                                                                                           |        |
| Oral communication. (presentation) | (4-5)<br>Clear and effective communication                                         | (2-3)<br>Communication is clear                                                                                              | (0-1)<br>Unclear communication                                                                            | ___/5  |
| Report                             | (4-5)<br>Clear and Effective writing and adherence to appropriate style guidelines | (2-3)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines | (0-1)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines | ___/5  |
| Total                              |                                                                                    |                                                                                                                              |                                                                                                           | ___/20 |



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|                      |                                         |                             |           |
|----------------------|-----------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>3</b>                                |                             |           |
| <b>Course Title:</b> | <b>Object Oriented Java Programming</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS3PCOOJ</b>                       | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-1</b>                            | <b>Total Credits:</b>       | <b>4</b>  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Hours |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <p><b>The History and Evolution of Java:</b> The Byte code, Features of Java, An overview of Java: Object-Oriented Programming, Structure of a Java program</p> <p><b>Data Types, Variables and Arrays:</b> The Primitive Types, Integers, Floating Point Types, characters, Booleans, Variables. Type conversion and casting, Arrays.</p> <p><b>Classes:</b> Fundamentals, Declaring Objects, Assigning Object Reference Variables, Methods, Constructors, this Keyword, Garbage Collection, Stack application.</p> <p><b>Methods and Classes:</b> Overloading Methods, Using Objects as Parameters, Argument Passing, Returning Objects, Access Control, static, final, Command-Line Arguments.</p> | 8     |
| 2        | <p><b>Inheritance:</b> Basic concepts, Member Access and Inheritance, Practical Example. Inheritance types, super, constructors, Method Overriding, Dynamic Method Dispatch, Abstract Classes, final with inheritance.</p> <p><b>String Handling:</b> String Constructor, String length, Special string Operations, Character Extraction, String comparison, Modifying a string, String Buffer.</p> <p><b>Generics:</b> About Generics, A simple Generic Example, General class with Two Type Parameters, General form of generic class.</p>                                                                                                                                                          | 8     |
| 3        | <p><b>Packages and Interfaces:</b> Packages, Packages and member access, importing packages, Interfaces, Default interface methods, Use static methods in an interface, Private Interface methods.</p> <p><b>Exception handling:</b> Fundamentals, Exception types, uncaught exceptions, try and catch, multiple catch clauses, nested try statements, throw, throws, finally, Java's built-in exceptions, User-defined exceptions.</p>                                                                                                                                                                                                                                                               | 9     |
| 4        | <p><b>Multithreaded Programming:</b> Java thread model, main thread, creating thread, creating multiple threads, isalive() and Join(), thread priorities, synchronization.</p> <p><b>Input/Output:</b> Exploring java.io - The I/O Classes and Interfaces, The Byte Streams.</p>                                                                                                                                                                                                                                                                                                                                                                                                                      | 9     |
| 5        | <p><b>Event Handling:</b> Two Event Handling Mechanisms, The Delegation Event Model, Events- Event Sources, Event Listeners, Event Classes- The MouseEventClass, Event Listener Interfaces-The MouseListener Interface, the MouseMotionListener Interface, Delegation Event Model – Handling Mouse Events. AWT: Working with Windows, Graphics and Text.</p> <p>AWT Classes, Window Fundamentals, Working with Frame Windows, Graphics.</p>                                                                                                                                                                                                                                                           | 8     |



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**Prescribed Text Book:**

| Sl. No. | Book Title                   | Authors         | Edition          | Publisher                | Year |
|---------|------------------------------|-----------------|------------------|--------------------------|------|
| 1       | Java: The Complete Reference | Herbert Schildt | 11 <sup>th</sup> | Tata McGraw-hill Edition | 2019 |

**Reference Text Books:**

| Sl. No. | Book Title                       | Authors                            | Edition         | Publisher             | Year |
|---------|----------------------------------|------------------------------------|-----------------|-----------------------|------|
| 1       | Introduction to JAVA Programming | Y. Daniel Liang                    | 9 <sup>th</sup> | Pearson Education     | 2012 |
| 2       | Programming in JAVA 5.0          | James P Cohoon,<br>Jack W Davidson | 1 <sup>st</sup> | Tata McGraw Hill      | 2006 |
| 3       | Programming with Java: A Primer  | E. Balagurusamy                    | 5 <sup>th</sup> | McGraw Hill Education | 2014 |

**E-Books:**

| Sl. No. | Book Title                                         | Authors                            | Edition         | Publisher                                    | Year | URL                                                                                                                                                                                                       |
|---------|----------------------------------------------------|------------------------------------|-----------------|----------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Java, Java, Java Object-Oriented Problem Solving   | R. Morelli,<br>R. Walde            | 3 <sup>rd</sup> | Pearson Education                            | 2012 | <a href="https://ia800303.us.archive.org/26/items/JavaJavaJavaObject-orientedProblemSolving/jjj-os.pdf">https://ia800303.us.archive.org/26/items/JavaJavaJavaObject-orientedProblemSolving/jjj-os.pdf</a> |
| 2       | The Art and Science of Java                        | Eric S. Roberts                    | 1 <sup>st</sup> | Greg Tobin                                   | 2007 | <a href="http://people.reed.edu/~jerry/121/materials/artsciencejava.pdf">http://people.reed.edu/~jerry/121/materials/artsciencejava.pdf</a>                                                               |
| 3       | Java Programming                                   | Wikibooks Contributors             | 7 <sup>th</sup> | wikibooks.org                                | 2016 | <a href="https://upload.wikimedia.org/wikipedia/commons/e/e7/Java_Programming.pdf">https://upload.wikimedia.org/wikipedia/commons/e/e7/Java_Programming.pdf</a>                                           |
| 4       | Think Java: How to Think like a Computer Scientist | Allen B. Downey,<br>Chris Mayfield | 1 <sup>st</sup> | Green Tea Press<br>Needham,<br>Massachusetts | 2016 | <a href="https://greenteapress.com/thinkjava6/thinkjava.pdf">https://greenteapress.com/thinkjava6/thinkjava.pdf</a>                                                                                       |

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|   |                                        |              |                 |              |      |                                                                                                                                                                                   |
|---|----------------------------------------|--------------|-----------------|--------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | Introduction to Programming using Java | David J. Eck | 7 <sup>th</sup> | Create Space | 2014 | <a href="https://www.win.tue.nl/~wstomv/edu/sc-hse/downloads/general/javanotes7-linked.pdf">https://www.win.tue.nl/~wstomv/edu/sc-hse/downloads/general/javanotes7-linked.pdf</a> |
|---|----------------------------------------|--------------|-----------------|--------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Course Outcomes (COs):**

|            |                                                                                |
|------------|--------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the knowledge of Java concepts to find the solution for a given problem. |
| <b>CO2</b> | Analyse the given Java application for correctness/functionalities.            |
| <b>CO3</b> | Develop Java programs / applications for a given requirement.                  |
| <b>CO4</b> | Conduct practical experiments for demonstrating features of Java.              |

**CO-PO-PSO mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 2   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     |     | 3   |     |     |     |     | 2   | 2   |      |      |      |      |      |
| CO4 |     |     | 2   |     |     |     |     |     |     |      |      |      |      | 1    |

**Assessment Plan for CIE:**

| Tool                                   | Remarks               | Marks     |
|----------------------------------------|-----------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 of 3</b>    | <b>20</b> |
| <b>Quiz</b>                            | -                     | -         |
| <b>Lab Component</b>                   | <b>CIE + Lab Test</b> | <b>25</b> |
| <b>Alternate Assessment Tool (AAT)</b> | 5                     | 5         |
| <b>Total</b>                           |                       | <b>50</b> |

**Laboratory Plan:**

1. Students should write the program / pseudocode for that week to be executed in the lab at the beginning of each lab and get it corrected by the batch-in-charge faculty and then start with the program execution.
2. Soft copy (PDF file) of all the programs along with the output needs to be submitted before the lab test.
3. Continuous Internal Evaluation for each lab is for 10 marks which includes execution of the program in the allotted lab time and showing the output. Observation book needs to be corrected on the same day itself.

**Note:**

- Student completes the program on the day within the lab timings and shows the output for any given input case: 10 marks
- Student completes the program on the day within the lab timings and shows the



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output for only some input cases: 8 marks

- Student completes the program on the day and shows the output for any given input case: 6 marks
  - Student completes the program on the day within one week and shows the output for any given input case: 4 marks
  - Submission any later: 0 marks
4. One Lab Test will be conducted, (mostly after theory Test-2). Lab Test will comprise programs which are completely different from the existing lab list of programs.
5. Marks split up for Lab:

Continuous Internal Evaluation: **100 marks à reduced to 10 marks**

Lab Test: **60 marks à reduced to 15 marks** (Writeup- 15 marks, Execution- 25 marks, Modification asked in the program for execution – 10 marks, Viva- 10 marks)

| Lab Program | Unit # | Marks for Continuous Evaluation | Program Details                                                                                                                                                                                                                                                                                                                                             |
|-------------|--------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1           | 1      | 10                              | Develop a Java program that prints all real solutions to the quadratic equation $ax^2+bx+c = 0$ . Read in a, b, c and use the quadratic formula. If the discriminate $b^2-4ac$ is negative, display a message stating that there are no real solutions.                                                                                                     |
| 2           | 1      | 10                              | Develop a Java program to create a class Student with members usn, name, an array credits and an array marks. Include methods to accept and display details and a method to calculate SGPA of a student.                                                                                                                                                    |
| 3           | 1      | 10                              | Create a class Book which contains four members: name, author, price, num_pages. Include a constructor to set the values for the members. Include methods to set and get the details of the objects. Include a toString( ) method that could display the complete details of the book. Develop a Java program to create n book objects.                     |
| 4           | 2      | 10                              | Develop a Java program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contain only the method printArea() that prints the area of the given shape. |



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|   |   |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---|---|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | 2 | 10 | <p>Develop a Java program to create a class Bank that maintains two kinds of account for its customers, one called savings account and the other current account. The savings account provides compound interest and withdrawal facilities but no cheque book facility. The current account provides cheque book facility but no interest. Current account holders should also maintain a minimum balance and if the balance falls below this level, a service charge is imposed.</p> <p>Create a class Account that stores customer name, account number and type of account. From this derive the classes Cur-acct and Sav-acct to make them more specific to their requirements. Include the necessary methods in order to achieve the following tasks:</p> <ul style="list-style-type: none"><li>a) Accept deposit from customer and update the balance.</li><li>b) Display the balance.</li><li>c) Compute and deposit interest</li><li>d) Permit withdrawal and update the balance</li></ul> <p>Check for the minimum balance, impose penalty if necessary and update the balance.</p> |
| 6 | 3 | 10 | <p>Create a package CIE which has two classes - Personal and Internals. The class Personal has members like usn, name, sem. The class Internals has an array that stores the internal marks scored in five courses of the current semester of the student. Create another package SEE which has the class External which is a derived class of Personal. This class has an array that stores the SEE marks scored in five courses of the current semester of the student. Import the two packages in a file that declares the final marks of n students in all five courses.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 7 | 3 | 10 | <p>Write a program that demonstrates handling of exceptions in inheritance tree. Create a base class called "Father" and derived class called "Son" which extends the base class. In Father class, implement a constructor which takes the age and throws the exception WrongAge( ) when the input age&lt;0. In Son class, implement a constructor that uses both father and son's age and throws an exception if son's age is &gt;=father's age.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 8 | 4 | 10 | <p>Write a program which creates two threads, one thread displaying "BMS College of Engineering" once every ten seconds and another displaying "CSE" once every two seconds.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |



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|    |                     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----|---------------------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9  | Open Ended Exercise | 10 | Write a program that creates a user interface to perform integer divisions. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num2 is displayed in the Result field when the Divide button is clicked. If Num1 or Num2 were not an integer, the program would throw a NumberFormatException. If Num2 were Zero, the program would throw an Arithmetic Exception Display the exception in a message dialog box. |
| 10 | Open Ended Exercise | 10 | Demonstrate Inter process Communication and deadlock                                                                                                                                                                                                                                                                                                                                                                                                 |

**Note:** Collect a report for the open-ended exercise

**Rubrics used for AAT evaluation:**

| Criteria                         | Exemplary                                                                        | Proficient                                                                   | Partially Proficient                                                                                              | Points  |
|----------------------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------|
| Implementation                   | (7-10)<br><br>Correct implementation of the project with appropriate validation. | (4-6)<br><br>Correct implementation according to project requirement.        | (0-3)<br><br>Code is not implemented in accordance with the project requirement.                                  | __ / 10 |
| Oral communication/ presentation | (5-4)<br><br>Clear and effective communication. Answers all the questions        | (3-2)<br><br>Communication is clear.<br><br>Answered most of the questions   | (1-0)<br><br>Unclear communication.<br><br>Responded to some, but not all, of the questions.                      | __ / 5  |
| Report                           | (5-4)<br><br>Clear articulation and well formatted.                              | (3-2)<br><br>Content is clearly articulated with minor errors in formatting. | (1-0)<br><br>Content is poorly articulated; fails to convey key ideas and also has multiple errors in formatting. | __/5    |
| Total                            |                                                                                  |                                                                              |                                                                                                                   | __/20   |



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|                      |                     |                             |           |
|----------------------|---------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>3</b>            |                             |           |
| <b>Course Title:</b> | <b>Logic Design</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS3PCLOD</b>   | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>2-0-0</b>        | <b>Total Credits:</b>       | <b>2</b>  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                                                                         | Hours    |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>1</b> | <b>Simplification of Boolean Expressions:</b> Boolean expressions and Notations, Karnaugh Maps- Up to Four-variable maps, Product and Sum term Representations on Karnaugh Maps, Minimization using Karnaugh Maps to obtain Minimal Expressions for Complete Boolean Functions, Minimal Sum and Product with Don't Care Conditions, The Quine-McClusky Method. | <b>6</b> |
| <b>2</b> | <b>Combinational Circuits:</b> Comparators, Decoders, Encoders, Multiplexers, Demultiplexers.                                                                                                                                                                                                                                                                  | <b>5</b> |
| <b>3</b> | <b>Programmable Logic Devices (PLDs):</b> PLD Notation, Programmable Read-Only Memories (PROMs), Programmable Logic Arrays (PLAs), Programmable Array Logic (PAL).                                                                                                                                                                                             | <b>6</b> |
| <b>4</b> | <b>Flip-Flops:</b> The Basic Bistable Element, Latches-SR Latch, The Gated D Latch, The Master Slave JK Flip Flop, Edge Triggered Flip Flops, Timing Diagram of Flip Flops, Characteristic equation of Flip Flops.                                                                                                                                             | <b>6</b> |
| <b>5</b> | <b>Counters and Design of Synchronous Sequential Circuits:</b> Introduction to Counters-Binary Ripple Counters, Design of Synchronous Counters using JK Flip Flops.<br><br><b>Design of Synchronous Sequential circuits:</b> Model selection, State Transition Diagram.                                                                                        | <b>5</b> |

**Prescribed Text Books:**

| Sl. No. | Book Title                          | Authors                                          | Edition         | Publisher        | Year |
|---------|-------------------------------------|--------------------------------------------------|-----------------|------------------|------|
| 1.      | Digital Principles and Design       | Donald. D. Givone                                | 1 <sup>st</sup> | Tata McGraw Hill | 2016 |
| 2.      | Digital Principles and Applications | Donald P Leach, Albert Paul Malvino, Goutam Saha | 8 <sup>th</sup> | Tata McGraw Hill | 2018 |



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**Reference Text Books:**

| Sl. No. | Book Title                                                                                                                                         | Authors                           | Edition         | Publisher        | Year |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------|------------------|------|
| 1       | Illustrative Approach to Logic Design                                                                                                              | R D Sudhaker Samuel               | 1 <sup>st</sup> | Sanguine-Pearson | 2010 |
| 2       | Digital Design: With an Introduction to the Verilog HDL and System Verilog, Digital Design :With an Introduction to Verilog HDL and System Verilog | M Morris Mano, Michael D. Ciletti | 6 <sup>th</sup> | Pearson          | 2018 |
| 3       | Analog and Digital Electronics                                                                                                                     | Charles H Roth, Larry L Kinney    | 1 <sup>st</sup> | Cengage Learning | 2019 |

**E-Books:**

| Sl. No. | Book Title                                         | Authors                                           | Edition         | Publisher    | Year | URL                                                                                                                                                                                                                                                         |
|---------|----------------------------------------------------|---------------------------------------------------|-----------------|--------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Introduction to Logic Design                       | Alan B. Marcovitz                                 | 3 <sup>rd</sup> | McGraw Hill  | 2010 | <a href="https://dl.icdst.org/pdfs/files3/fcba7ca1c74a45934f11dbb72e6678b9.pdf">https://dl.icdst.org/pdfs/files3/fcba7ca1c74a45934f11dbb72e6678b9.pdf</a>                                                                                                   |
| 2       | Foundation of Digital Electronics and Logic Design | Subir Kumar Sarkar, Asish Kumar De, Souvik Sarkar | 1 <sup>st</sup> | Pan Stanford | 2014 | <a href="https://72arkarcy.wordpress.com/wp-content/uploads/2016/09/foundation-of-digital-electronics-and-logic-design-2014.pdf">https://72arkarcy.wordpress.com/wp-content/uploads/2016/09/foundation-of-digital-electronics-and-logic-design-2014.pdf</a> |



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**MOOC Courses:**

| Sl. No. | Course name                     | Course offered by | Year | URL                                                                                                                       |
|---------|---------------------------------|-------------------|------|---------------------------------------------------------------------------------------------------------------------------|
| 1.      | Hardware Modeling using Verilog | NPTEL             | 2019 | <a href="https://onlinecourses.nptel.ac.in/noc19_cs72/preview">https://onlinecourses.nptel.ac.in/noc19_cs72/preview</a>   |
| 2.      | Digital Circuits                | NPTEL             | 2022 | <a href="https://onlinecourses.nptel.ac.in/noc22_ee110/preview">https://onlinecourses.nptel.ac.in/noc22_ee110/preview</a> |

**Course Outcomes (COs):**

|            |                                                                                              |
|------------|----------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply principles of logic design to construct digital circuits.                              |
| <b>CO2</b> | Analyse the functionalities of digital circuits.                                             |
| <b>CO3</b> | Design and simulate combinational and sequential logic circuits from functional description. |

**CO-PO-PSO Mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     |     | 2   |     |     |     |     | 2   | 2   |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                            | Remarks     | Marks     |
|---------------------------------|-------------|-----------|
| Internals                       | Best 2 of 3 | 40        |
| Quiz                            | --          | --        |
| Lab Component                   | --          | --        |
| Alternate Assessment Tool (AAT) | One         | 10        |
| <b>Total</b>                    |             | <b>50</b> |

**AAT -1(simulation)**

Students are supposed to show the implementation of any given digital circuit using iVerilog or any other open-source simulation software. The problem statement to be framed for which the student has to come up with design first using pen and paper and then implement using iVerilog or any other open-source simulation software and demonstrate the same. A report has to be submitted in the prescribed format. Also, a demonstration of simulated scenarios along with a report has to be submitted.



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| Sl. No | Week                | Activity                                                              |
|--------|---------------------|-----------------------------------------------------------------------|
| 1      | 1st and 2nd         | Formation of groups. Note: Student groups of size 2 to 4 members only |
| 2      | 3rd                 | AAT topic selection by each group                                     |
| 3      | 4th, , 5th, 6th,7th | Demonstration of iVerilog software                                    |
| 4      | 8th , 9th , 10th    | Demonstration of the simulated scenarios in the chosen simulator.     |
| 5      | 11th,12th           | AAT Report Preparation                                                |

**AAT Plan (Assignment):**

1. Assignments to be given to students at the end of each unit where students solve problems related to each unit. All faculty handling the course need to discuss and come up with problems to be given to students.
2. Total: 5 assignments, Marks :5\*4=20 marks
3. Each assignment carries 5 marks and the sum of the best 4 out of 5 assignments to be taken for consideration.
4. Timely submission of the assignment is must and it must be handwritten only. The criteria for evaluation depend on the correctness and timely submission. Plagiarism also to be taken care of.
5. The AAT marks will be the sum of Simulation and Assignment.
  - Simulation - 20 Marks
  - Assignment - 20 Marks

**Note:** AAT will be evaluated for 40 marks and reduced to 10 marks.



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|                      |                                    |                             |           |
|----------------------|------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>3</b>                           |                             |           |
| <b>Course Title:</b> | <b>Database Management Systems</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS3PCDBM</b>                  | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-1</b>                       | <b>Total Credits:</b>       | <b>4</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Hours</b> |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <p><b>Introduction to Databases:</b> Introduction, An Example, Characteristics of Database approach, Advantages of using DBMS approach, when not to use a DBMS.</p> <p><b>Database System Concepts and Architecture:</b> Data models, Schemas and instances, Three schema architecture.</p> <p><b>SQL:</b> SQL Data Definition and Data Types specifying basic constraints in SQL, Schema Change Statement in SQL, Basic retrieval queries in SQL, Insert, Delete and Update statements in SQL, Additional features of SQL, more complex SQL Queries, Views (Virtual Tables) in SQL, Triggers and Stored Procedures.</p>                                                         | <b>9</b>     |
| <b>2</b>        | <p><b>Data Modelling using the Entity-Relationship (ER) model:</b> Using High-Level conceptual Data Models for Database Design, A sample Database Application, Entity types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity types, Refining the ER Design, ER Diagrams, Relationship Types of Degree Higher than two, Relational Database Design using ER-to-Relational Mapping.</p> <p><b>Relational Algebra:</b> Unary Relational Operations, SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Aggregate functions and grouping</p> | <b>9</b>     |
| <b>3</b>        | <p><b>Database Design Theory and Normalization:</b> Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multi-valued Dependencies and a Fourth Normal Form, Join Dependencies, Fifth Normal Form.</p>                                                                                                                                                                                                                                                                                                                                    | <b>8</b>     |
| <b>4</b>        | <p><b>Transaction Processing, Concurrency Control:</b> Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Two-Phase Locking Techniques for Concurrency Control. ARIES Recovery Algorithm</p>                                                                                                                                                                                                                                                                                                                    | <b>8</b>     |
| <b>5</b>        | <p><b>NoSQL:</b> An overview of NoSQL, Characteristics of NoSQL, NoSQL storage types, Advantages and Drawbacks of NoSQL, Case Study: Application definition, Requirement Analysis, Implementation using MongoDB, Database Queries, Writing Queries.</p> <p><b>Vector database:</b> Introduction, Vector Index, Working of Vector database.</p>                                                                                                                                                                                                                                                                                                                                   | <b>8</b>     |



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**Prescribed Text Books:**

| Sl. No. | Book Title                       | Authors                              | Edition         | Publisher | Year |
|---------|----------------------------------|--------------------------------------|-----------------|-----------|------|
| 1.      | Fundamentals of Database Systems | Ramez Elmasri,<br>Shamkant B Navathe | 6 <sup>th</sup> | Pearson   | 2017 |
| 2.      | Getting Started with NoSQL       | Gaurav Vaish                         | 1 <sup>st</sup> | Packt     | 2013 |
| 3.      | Vector Database                  | Roie Schwaber-Cohen                  | 1 <sup>st</sup> | Pinecone  | 2023 |

**Reference Text Books:**

| Sl. No. | Book Title                          | Authors                                                       | Edition         | Publisher         | Year |
|---------|-------------------------------------|---------------------------------------------------------------|-----------------|-------------------|------|
| 1.      | Database Management Systems         | Ramakrishnan,<br>Gehrke                                       | 3 <sup>rd</sup> | McGraw Hill       | 2014 |
| 2.      | Database Systems: The Complete Book | Hector Garcia-Molina,<br>Jeffrey D. Ullman,<br>Jennifer Widom | 2 <sup>nd</sup> | Pearson Education | 2001 |
| 3.      | Database System Concepts            | Abraham Silberschatz,<br>Henry F. Korth,<br>S. Sudarshan      | 6 <sup>th</sup> | Tata McGraw-Hill  | 2010 |

**E-Book:**

| Sl. No. | Book Title                                    | Authors     | Edition         | Publisher         | Year | URL                                                                                                                                                                                                                 |
|---------|-----------------------------------------------|-------------|-----------------|-------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.      | An Introduction to Relational Database Theory | Hugh Darwen | 1 <sup>st</sup> | Ventus Publishing | 2012 | <a href="https://dvikan.no/ntnu-studentserver/kompendi er/an-introduction-to-relational-database-theory.pdf">https://dvikan.no/ntnu-studentserver/kompendi er/an-introduction-to-relational-database-theory.pdf</a> |



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**MOOC Course:**

| Sl. No. | Course name                 | Course Offered By | Year | URL                                                                                                                     |
|---------|-----------------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------------|
| 1.      | Data Base Management System | NPTEL             | 2022 | <a href="https://onlinecourses.nptel.ac.in/noc22_cs91/preview">https://onlinecourses.nptel.ac.in/noc22_cs91/preview</a> |

**Course Outcomes (COs):**

|            |                                                                            |
|------------|----------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concepts of database management system for various applications. |
| <b>CO2</b> | Analyse database concepts for a given problem.                             |
| <b>CO3</b> | Design conceptual data model for database applications.                    |
| <b>CO4</b> | Demonstrate commands to create, manipulate and query data in a database.   |

**CO-PO-PSO Mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 2   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     |     | 3   |     |     |     |     |     |     |      |      | 2    |      |      |
| CO4 |     |     |     |     | 3   |     |     |     |     |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                                   | Remarks               | Marks      |
|----------------------------------------|-----------------------|------------|
| <b>Internals</b>                       | <b>Best 2 of 3</b>    | <b>20</b>  |
| <b>Quiz</b>                            | <b>One</b>            | <b>5</b>   |
| <b>Lab Component</b>                   | <b>CIE + Lab Test</b> | <b>25</b>  |
| <b>Alternate Assessment Tool (AAT)</b> | <b>---</b>            | <b>---</b> |
| <b>Total</b>                           |                       | <b>50</b>  |

**Laboratory Plan:**

1. Every lab, the student will be evaluated for 10 marks
  - a. If the student successfully finishes the assigned task of the lab and on spot task, in the stipulated lab hours, 10 marks will be given to the student
  - b. If the student could finish only assigned task in the stipulated lab hours, then the student will get 8 marks.
  - c. If the student could not complete the assigned task of that day lab, the student can show the completion on the same day or next day. The student will get 7 marks
  - d. If the student could not complete as like Case 'c', then partial mark will be given based on the completion status.
  - e. If the student is absent for the lab, and he /she finishes the assigned task and shows the execution before the next lab, the student will get 4 marks (Attendance will not be given)



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**Note:** Case 'e' is allowed only twice [Only if the student is absent because of illness]

**RUBRICS / MARKS EVALUATION (50) – These 50 marks will be converted to 10 marks**

| TITLE          | MARKS |
|----------------|-------|
| ER DIAGRAM     | 15    |
| SCHEMA DIAGRAM | 5     |
| IMPLEMENTATION | 15    |
| SQL QUERY      | 15    |

**Instructions for the lab test:**

1. Test will be conducted in two days. First-day students will be given the questions to write ER diagram, schema diagram and start the implementation in the Lab. **(Group Task - 4 members)**
2. On the second day, students will be given an SQL query to write the answer and demonstrate the same on the implemented database. **(Individual task)**

**Final CIE marks (50) will be allotted as follows:**

Regular lab (10 marks) + Record (5 marks) + Test (10 marks)

**Writing SQL Queries for the following database systems:**

| Experiment # | Name of Experiment                |
|--------------|-----------------------------------|
| 1            | Insurance Database                |
| 2            | More Queries Insurance Database   |
| 3            | Bank Database                     |
| 4            | More Queries on Bank Database     |
| 5            | Employee Database                 |
| 6            | More Queries on Employee Database |
| 7            | Supplier Database                 |
| 8            | No SQL - Student Database         |
| 9            | No SQL - Customer Database        |
| 10           | No SQL - Restaurant Database      |



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|                      |                        |                             |           |
|----------------------|------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>3</b>               |                             |           |
| <b>Course Title:</b> | <b>Data Structures</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS3PCDST</b>      | <b>Total contact hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-1</b>           | <b>Total Credits:</b>       | <b>4</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Hours</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Introduction:</b> Data and Information, Data Structure, Classification of Data Structures, Data structure versus File Organization, Operations on Data Structure. Introduction to Structures, pointers and Dynamic Memory allocation.<br><br><b>Stacks:</b> Operations, array representations of stacks, Stack applications -Infix to postfix conversion, Postfix expression evaluation, function call tracing, recursion.                         | <b>8</b>     |
| <b>2</b>        | <b>Queues:</b> Introduction, Basic concept, queue operations, circular queue, priority queues, double ended queues.<br><br><b>Linked List:</b> Singly linked list implementation, insertion, deletion and searching operations on linear list.                                                                                                                                                                                                        | <b>8</b>     |
| <b>3</b>        | <b>Linked List:</b> Circularly linked lists- insertion, deletion and searching Operations for Circularly linked lists, doubly linked list implementation, insertion, deletion and searching operations, applications of linked lists – Stack and queue implementation, maintaining directory of names, Manipulation of polynomials (addition), representing sparse matrices.                                                                          | <b>9</b>     |
| <b>4</b>        | <b>Trees:</b> Definitions, tree representation, properties of trees, Binary tree, Binary tree representation, Binary tree properties, Binary tree traversals, Binary tree implementation, Binary Search Tree operations and its implementation, Applications of trees.<br><br><b>Graph:</b> Introduction, Trees versus Graph, Graph Traversals: Breadth-First Search (BFS) – Examples and programs, Depth-First Search (DFS) – Examples and programs. | <b>9</b>     |
| <b>5</b>        | <b>Hashing Techniques:</b> Hash Table Representation: hash functions, collision resolution-separate chaining, open addressing-linear probing, quadratic probing, double hashing.                                                                                                                                                                                                                                                                      | <b>8</b>     |

**Prescribed Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                    | <b>Authors</b>                 | <b>Edition</b>  | <b>Publisher</b>        | <b>Year</b> |
|----------------|--------------------------------------|--------------------------------|-----------------|-------------------------|-------------|
| 1              | Fundamentals of Data Structures in C | Horowitz Sahni, Anderson Freed | 2 <sup>nd</sup> | Universities Press      | 2008        |
| 2              | Data Structures using C              | Reema Thareja                  | 2 <sup>nd</sup> | Oxford University Press | 2014        |



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|   |                                          |                                              |                 |     |      |
|---|------------------------------------------|----------------------------------------------|-----------------|-----|------|
| 3 | A Simplified Approach to Data Structures | Lalit Goyal,<br>Vishal Goyal,<br>Pawan Kumar | 1 <sup>st</sup> | SPD | 2014 |
|---|------------------------------------------|----------------------------------------------|-----------------|-----|------|

**Reference Text Books:**

| Sl. No. | Book Title                                          | Authors                                                         | Edition         | Publisher         | Year |
|---------|-----------------------------------------------------|-----------------------------------------------------------------|-----------------|-------------------|------|
| 1       | Data Structures using C                             | Aaron M. Tenenbaum,<br>Yedidyah Langsam,<br>Moshe J. Augenstein | 5 <sup>th</sup> | Pearson Education | 2007 |
| 2       | An Introduction to Data Structure with Applications | Jean - Paul Tremblay,<br>Paul Sorenson                          | 2 <sup>nd</sup> | Tata MacGraw Hill | 2007 |

**E-Book:**

| Sl. No. | Book Title              | Authors       | Edition         | Publisher               | Year | URL                                                                                                                                                                                                                                                                                                                 |
|---------|-------------------------|---------------|-----------------|-------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Data Structures using C | Reema Thareja | 2 <sup>nd</sup> | Oxford University Press | 2014 | <a href="http://www.ir.juit.ac.in:8080/jspui/bitstream/123456789/5374/1/Data%20structures%20using%20C%202nd%20Ed.%20by%20Thareja%2C%20Reema%20282014%29.pdf">http://www.ir.juit.ac.in:8080/jspui/bitstream/123456789/5374/1/Data%20structures%20using%20C%202nd%20Ed.%20by%20Thareja%2C%20Reema%20282014%29.pdf</a> |

**MOOC Courses:**

| Sl. No. | Course name                    | Course offered by | Year | URL                                                                                                         |
|---------|--------------------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------|
| 1       | Data Structures                | Coursera          | 2022 | <a href="https://www.coursera.org/learn/data-structures">https://www.coursera.org/learn/data-structures</a> |
| 2       | Data Structures and Algorithms | NPTEL             | 2022 | <a href="https://nptel.ac.in/courses/106102064/">https://nptel.ac.in/courses/106102064/</a>                 |

**Course Outcomes (COs):**

|            |                                                                                                                    |
|------------|--------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concept of linear and nonlinear data structures                                                          |
| <b>CO2</b> | Analyse data structure operations for a given problem                                                              |
| <b>CO3</b> | Design and develop solutions using the operations of linear and nonlinear data structure for a given specification |
| <b>CO4</b> | Conduct practical experiments for demonstrating the operations of different data structures.                       |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****CO-PO-PSO Mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 2   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 2   |     |     |     |     |     |     |     |      |      |      |      | 2    |
| CO3 |     |     | 3   |     |     |     |     |     |     |      |      |      |      | 3    |
| CO4 |     |     |     |     | 3   |     |     |     |     |      | 3    |      |      | 3    |

**Assessment Plan for CIE:**

| Tool                            | Remarks        | Marks |
|---------------------------------|----------------|-------|
| Internals                       | Best 2 of 3    | 20    |
| Quiz                            | -              | -     |
| Lab Component                   | CIE + Lab test | 25    |
| Alternate Assessment Tool (AAT) | ONE            | 05    |
| Total                           |                | 50    |

**Laboratory Plan:**

1. Students should write the program (pseudocode) for that week to be executed in the lab at the beginning of each lab and get it corrected by the batch-in-charge faculty and then start with the program execution.
2. Soft copy (PDF file) of all the programs along with the output needs to be submitted before the lab test.
3. Continuous Internal Evaluation for each lab is for 10 marks which includes execution of the program in the allotted lab time and showing the output. If Leetcode program is present for a particular lab, student needs to complete that also within the allotted lab slot only and show the output. Observation book needs to be corrected on the same day itself.

**Note:** Wherever LeetCode program is present, the program to be executed will be shared during the particular lab week.

**Note:** Student completes the program on the day within the lab timings and shows the output for any given input case: 10 marks

Student completes the program on the day within the lab timings and shows the output for only

some input cases: 8 marks

Student completes the program on the day and shows the output for any given input case: 6 marks

Student completes the program on the day within one week and shows the output for any given input case: 4 marks

Submission any later: 0 marks



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4. One Lab Test will be conducted for all the 10 programs. Lab Test will comprise programs which are completely different from the existing lab list of programs.

5. Marks split up for Lab:

Continuous Internal Evaluation: **100 marks à reduced to 10 marks**

Lab Test: **60 marks à reduced to 15 marks** (Writeup- 15 marks, Execution- 25 marks, Modification asked in the program for execution – 10 marks, Viva- 10 marks)

| Lab Program | Unit # | Marks for Continuous Evaluation | Program Details                                                                                                                                                                                                                           |
|-------------|--------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1           | 1      | 10                              | Write a program to simulate the working of stack using an array with the following:<br>a) Push<br>b) Pop<br>c) Display<br>The program should print appropriate messages for stack overflow, stack underflow                               |
| 2           | 1      | 5                               | WAP to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply) and / (divide)              |
|             |        | 5                               | Demonstration of account creation on LeetCode platform<br>Program - Leetcode platform                                                                                                                                                     |
| 3           | 2      | 5                               | a) WAP to simulate the working of a queue of integers using an array. Provide the following operations: Insert, Delete, Display<br>The program should print appropriate messages for queue empty and queue overflow conditions            |
|             |        | 5                               | b ) WAP to simulate the working of a circular queue of integers using an array. Provide the following operations: Insert, Delete & Display<br>The program should print appropriate messages for queue empty and queue overflow conditions |



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|   |   |   |                                                                                                                                                                                                                                        |
|---|---|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | 2 | 5 | WAP to Implement Singly Linked List with following operations<br>a) Create a linked list.<br>b) Insertion of a node at first position, at any position and at end of list.<br>Display the contents of the linked list.                 |
|   |   | 5 | Program - Leetcode platform                                                                                                                                                                                                            |
| 5 | 3 | 5 | WAP to Implement Singly Linked List with following operations<br>a) Create a linked list.<br>b) Deletion of first element, specified element and last element in the list.<br>c) Display the contents of the linked list.              |
|   |   | 5 | Program - Leetcode platform                                                                                                                                                                                                            |
| 6 | 3 | 5 | a) WAP to Implement Single Link List with following operations: Sort the linked list, Reverse the linked list, Concatenation of two linked lists.                                                                                      |
|   |   | 5 | b) WAP to Implement Single Link List to simulate Stack & Queue Operations.                                                                                                                                                             |
| 7 | 3 | 5 | WAP to Implement doubly link list with primitive operations<br>a) Create a doubly linked list.<br>b) Insert a new node to the left of the node.<br>c) Delete the node based on a specific value<br>d) Display the contents of the list |
|   |   | 5 | Program - Leetcode platform                                                                                                                                                                                                            |
| 8 | 4 | 5 | Write a program<br>a) To construct a binary Search tree.<br>b) To traverse the tree using all the methods i.e., in-order, preorder and post order<br>c) To display the elements in the tree.                                           |
|   |   | 5 | Program - Leetcode platform                                                                                                                                                                                                            |
| 9 | 4 | 5 | a) Write a program to traverse a graph using BFS method.                                                                                                                                                                               |



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|    |   |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----|---|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |   | 5  | b) Write a program to check whether given graph is connected or not using DFS method.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 10 | 5 | 10 | <p>Given a File of N employee records with a set K of Keys(4-digit) which uniquely determine the records in file F.</p> <p>Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are integers.</p> <p>Design and develop a Program in C that uses Hash function <math>H: K \rightarrow L</math> as <math>H(K) = K \bmod m</math> (remainder method), and implement hashing technique to map a given key K to the address space L.</p> <p>Resolve the collision (if any) using linear probing.</p> |



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|                      |                               |                             |           |
|----------------------|-------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>3</b>                      |                             |           |
| <b>Course Title:</b> | <b>Unix Shell Programming</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS3PCUSP</b>             | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-1-0</b>                  | <b>Total Credits:</b>       | <b>1</b>  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                     | Hours |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Overview of UNIX:</b> Introduction to UNIX Operating System, Architecture, Kernel and Shell, Features, Internal and External Commands, Basic Commands: cal, date, echo, bc, script, passwd, PATH, who, uname, pwd, cd, mkdir, rmdir. Command Structure, Shell Script and Shell Programming, UNIX Server | 6     |
| 2        | <b>File System:</b> Introduction to File system, File creations and its related commands cat, cp, rm, mv, more, file, ls, wc, pg, cmp, comm, diff. Zipping & unzipping files, gzip, tar, zip. File Permissions with chgrp & chmod                                                                          | 6     |
| 3        | <b>Managing file links:</b> hard links; symbolic links; Process Control: Viewing a Process, Command to display Process, Process Attributes, Process States, Process Fields, ps Commands options, Handling Jobs, Foreground & Background Jobs                                                               | 6     |
| 4        | <b>Shell Programming:</b> Shell as an interpreter, shell variables, environment variables, Keywords, Assignment Statements, read, echo, Shell scripts and execution methods, exit Status of a Command                                                                                                      | 5     |
| 5        | Branching Control Structures, Loop-Control Structure, Continue and break Statements, Expressions, Command Substitution, Command Line Arguments and Functions.                                                                                                                                              | 5     |

**Prescribed Text Books:**

| Sl. No. | Book Title                       | Authors                                 | Edition         | Publisher               | Year |
|---------|----------------------------------|-----------------------------------------|-----------------|-------------------------|------|
| 1       | The UNIX Programming Environment | Brain W Kernighan, Rob Pike             | 1 <sup>st</sup> | Pearson Education India | 2015 |
| 2       | UNIX and Shell Programming       | Behrouz A. Forouzan, Richard F. Gilberg | 1 <sup>st</sup> | Cengage Learning India  | 2003 |



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**Reference Text Books:**

| Sl. No. | Book Title                               | Authors          | Edition         | Publisher         | Year |
|---------|------------------------------------------|------------------|-----------------|-------------------|------|
| 1       | Unix Concepts and Applications           | Sumitabha Das    | 4 <sup>th</sup> | TMH               | 2006 |
| 2       | Introduction to Unix & Shell Programming | Venkatesh Murthy | 1 <sup>st</sup> | Pearson Education | 2010 |

**E-Book:**

| Sl. No. | Book Title                | Authors                                            | Edition         | Publisher              | Year | URL                                                                                                                                                                                         |
|---------|---------------------------|----------------------------------------------------|-----------------|------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Beginning Shell Scripting | Eric Foster-Johnson, John C. Welch, Micah Anderson | 1 <sup>st</sup> | Wiley Publishing, Inc. | 2005 | <a href="https://fisnikd.wordpress.com/wp-content/uploads/2009/11/beginning-shell-scripting.pdf">https://fisnikd.wordpress.com/wp-content/uploads/2009/11/beginning-shell-scripting.pdf</a> |

**MOOC Courses:**

| Sl. No. | Course name                                                 | Course Offered By | Year | URL                                                                                                                                                                                                 |
|---------|-------------------------------------------------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Unix and Shell Programming for Beginners                    | Udemy             | 2022 | <a href="https://www.udemy.com/course/shellprogramming">https://www.udemy.com/course/shellprogramming</a>                                                                                           |
| 2       | Hands-on Introduction to Linux Commands and Shell Scripting | Coursera          | 2023 | <a href="https://www.coursera.org/learn/hands-on-introduction-to-linux-commands-and-shell-scripting">https://www.coursera.org/learn/hands-on-introduction-to-linux-commands-and-shell-scripting</a> |

**Course Outcomes (COs):**

|            |                                                                                                 |
|------------|-------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply basic concepts of UNIX Architecture, File system and basic commands to Shell Programming. |
| <b>CO2</b> | Interpret Linux Commands and shell environments.                                                |
| <b>CO3</b> | Analyse task requirements to determine suitable automation approaches.                          |



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**CO-PO-PSO mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     | 2   |     |     |     |     |     |     |     |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                            | Remarks              | Marks |
|---------------------------------|----------------------|-------|
| Internals                       | ---                  | ---   |
| Quiz                            | One                  | 10    |
| Lab Component                   | 05 CIE (05*04 Marks) | 20    |
| Alternate Assessment Tool (AAT) | TWO (10+10)          | 20    |
| Total                           |                      | 50    |

**Laboratory Plan:**

Introductions to the students - Each unit is associated with Continuous evaluation. Five Continuous evaluation in form of quiz /worksheet / script execution will be conducted in the tutorial hours after completion of each unit.



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|                      |                                   |                             |           |
|----------------------|-----------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>3</b>                          |                             |           |
| <b>Course Title:</b> | <b>Full Stack Web development</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS3AEFWD</b>                 | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-0-1</b>                      | <b>Total Credits:</b>       | <b>1</b>  |

**Guidelines:**

- This course focuses on developing comprehensive skills in Full Stack Web Application Development. Students will learn to develop both front-end and back-end components of web applications, integrate with databases and external services, and apply best practices in web development.
- Under this project work, student should develop Advanced Web based Application using technologies such as PHP, Python, Node JS, React, Angular.
- Students can form a group with minimum of three and maximum of four.
- Teacher allotted for project work to students should teach full stack technologies like Node JS, React, etc., during Class/Lab hours as per the allotment. Teacher allotted for project work should guide the students in choosing the topic and towards carrying out project work and complete the evaluation of assigned students.

**Reference Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                                                                         | <b>Authors</b> | <b>Edition</b>  | <b>Publisher</b>        | <b>Year</b> |
|----------------|-------------------------------------------------------------------------------------------|----------------|-----------------|-------------------------|-------------|
| 1              | Modern Full-Stack Development: Using Type Script, React, Node.js                          | Frank Zammetti | 1 <sup>st</sup> | Apress                  | 2020        |
| 2              | Beginning MERN Stack , Build and Deploy a Full Stack MongoDB, Express, React, Node.js App | Greg Lim       | 1 <sup>st</sup> | Amazon Digital Services | 2021        |

**Tutorial Links:**

1. <https://www.springboard.com/resources/learning-paths/web-development-python-django/>
2. <https://www.coursera.org/learn/introduction-to-web-development-with-html-css-javascript>
3. <https://www.boardinfinity.com/micro-learning/full-stack-development-course-with-certification>
4. <https://www.udemy.com/course/next-js-the-complete-developers-guide/>
5. <https://www.udemy.com/course/nextjs-build-full-stack-apps-with-nextjs-using-redux/>



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### **Course Outcomes (COs):**

|            |                                                                                               |
|------------|-----------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply fundamentals of front-end and backend technologies to develop dynamic web applications. |
| <b>CO2</b> | Design client server web applications using modern tools and databases.                       |
| <b>CO3</b> | Develop user centric full stack application integrating databases and external services       |
| <b>CO4</b> | Demonstrate teamwork and problem-solving skill in project development                         |

### **CO-PO-PSO mapping:**

|            | PO1      | PO2 | PO3      | PO4 | PO5      | PO6      | PO7 | PO8      | PO9      | PO10 | PO11 | PSO1 | PSO2     | PSO3 |
|------------|----------|-----|----------|-----|----------|----------|-----|----------|----------|------|------|------|----------|------|
| <b>CO1</b> | <b>3</b> |     |          |     |          |          |     |          |          |      |      |      |          |      |
| <b>CO2</b> |          |     | <b>3</b> |     | <b>2</b> |          |     |          |          |      |      |      | <b>3</b> |      |
| <b>CO3</b> |          |     | <b>3</b> |     | <b>2</b> | <b>2</b> |     |          |          |      |      |      |          |      |
| <b>CO4</b> |          |     |          |     |          |          |     | <b>3</b> | <b>3</b> |      |      |      |          |      |

### **Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>             | <b>Marks</b> |
|----------------------------------------|----------------------------|--------------|
| <b>Internals</b>                       | ---                        | ---          |
| <b>Quiz</b>                            | ---                        | ---          |
| <b>Lab Component</b>                   | <b>CIE through Reviews</b> | <b>50</b>    |
| <b>Alternate Assessment Tool (AAT)</b> | ---                        | ---          |
| <b>Total</b>                           |                            | <b>50</b>    |

| <b>Criteria</b>                    | <b>Excellent</b>                                                                                               | <b>Good</b>                                                             | <b>Satisfactory</b>                                        | <b>Needs Improvement</b>                                 | <b>Points</b> |
|------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------|---------------|
| Problem Identification & Relevance | (18-16)<br>Clearly articulates a significant social/environmental issue with insightful, innovative solutions. | (15-10)<br>Recognizes a pertinent issue and offers practical solutions. | (9-5)<br>Identifies a basic issue with standard solutions. | (4-0)<br>Fails to identify a relevant issue or solution. | /18           |



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|                             |                                                                                                                                                         |                                                                                                |                                                                                      |                                                                               |     |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-----|
| Technical Implementation    | (28-21)<br>Exemplary implementation of full-stack technologies, showcasing efficiency, integrity, scalability, sustainability and technical excellence. | (20-11)<br>Reliable and proficient technical performance and integrity meeting key objectives. | (10-5)<br>Basic implementation incorporating essential features and functionalities. | (4-0)<br>Inadequate or incomplete technical implementation.                   | /28 |
| User Experience & Interface | (20-15)<br>Exceptional UI/UX design, prioritizing intuitiveness and user-friendliness, with a professional standard of execution.                       | (14-10)<br>Competent UI design focused on usability and functionality.                         | (9-5)<br>Basic UI design encompassing essential functions and user needs.            | (4-0)<br>Poor or non-functional user interface, lacking in user-centricity.   | /20 |
| Group Participation         | (12-9)<br>Exhibits active engagement, exceptional collaboration, and effective teamwork throughout the project lifecycle.                               | (8-6)<br>Consistent participation and constructive collaboration within the group.             | (5-3)<br>Minimal but noticeable participation and occasional contributions.          | (2-0)<br>Lack of active participation and collaboration in the group.         | /12 |
| Presentation                | (10-8)<br>Professional, engaging presentation with outstanding visuals and comprehensive content, demonstrating exceptional delivery skills.            | (7-6)<br>Well-structured presentation with clear content and effective delivery.               | (5-3)<br>Basic presentation with some structure and varying delivery quality.        | (2-0)<br>Disorganized presentation lacking in coherence and adequate content. | /10 |



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|                        |                                                                                                                                             |                                                                                   |                                                                                 |                                                                              |     |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------|-----|
| Report & Documentation | (12-9)<br>Comprehensive report covering all project aspects with meticulous documentation, including methodology, design, and future scope. | (8-6)<br>Well-structured report with detailed coverage of project implementation. | (5-3)<br>Basic report with limited content, covering essential project details. | (2-0)<br>Poorly structured and incomplete report, lacking essential details. | /12 |
| Total                  |                                                                                                                                             |                                                                                   |                                                                                 |                                                                              | 100 |



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|                      |                          |                             |           |
|----------------------|--------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>3</b>                 |                             |           |
| <b>Course Title:</b> | <b>Technical Writing</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS3AETEW</b>        | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-0-1</b>             | <b>Total Credits:</b>       | <b>1</b>  |

**Introduction:**

- The students will explore the theory and practice of writing in a broad range of fields, such as the business, scientific, and industrial fields.
- Students will examine a variety of professional writing samples to gain an understanding of the skills needed to successfully communicate through professionally written e-mails, memos, business letters, and various types of reports and analyses.
- Students will learn to evaluate and respond to the ideas that they encounter within the selections. The course will aim to develop students' writing skills, essential for the production of professional documents.

**Reference Text Books:**

| <b>Sl. No</b> | <b>Book Title</b>                                                                              | <b>Authors</b>      | <b>Edition</b>  | <b>Publisher</b>        | <b>Year</b> |
|---------------|------------------------------------------------------------------------------------------------|---------------------|-----------------|-------------------------|-------------|
| 1             | Writing in the Technical Fields: A Practical Guide                                             | Ewald, Thorsten     | 2 <sup>nd</sup> | Oxford University Press | 2017        |
| 2             | Technical Writing: A Practical Guide for Engineers, Scientists, and Nontechnical Professionals | Laplante, Phillip A | 2 <sup>nd</sup> | CRC Press               | 2019        |

**Tutorial Links:**

1. <https://writingcenter.unc.edu/tips-and-tools/>
2. <https://owl.purdue.edu/owl/>
3. <https://pressbooks.bccampus.ca/technicalwriting/>

**Course Outcomes (COs):**

|            |                                                                                           |
|------------|-------------------------------------------------------------------------------------------|
| <b>CO1</b> | Write personal and academic responses to written works using appropriate terminology      |
| <b>CO2</b> | Apply reading skills to understand and evaluate and summarize various technical documents |



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**CO-PO-PSO mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     | 3   |      | 2    |      |      |      |
| CO2 | 3   |     |     |     | 3   |     |     | 3   | 3   |      | 2    |      |      |      |

**Assessment Plan for CIE:**

| Tool                            | Remarks             | Marks     |
|---------------------------------|---------------------|-----------|
| Internals                       | ---                 | ---       |
| Quiz                            | ---                 | ---       |
| Lab Component                   | ---                 | --        |
| Alternate Assessment Tool (AAT) | CIE through Reviews | 50        |
| <b>Total</b>                    |                     | <b>50</b> |

**Activity Plan:**

| Sl. No | Week                                                     | Activity                                                                                                     |
|--------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| 1      | 1 <sup>st</sup>                                          | Write at least four multi-paragraph, technical documents of at least 500 words.                              |
| 2      | 2 <sup>nd</sup>                                          | Write at least two in-class documents.                                                                       |
| 3      | 3 <sup>rd</sup> and 4 <sup>rd</sup>                      | Writing exercises such as summaries, journals, reading responses, reading comprehension questions.           |
| 4      | 5 <sup>th</sup> and 6 <sup>th</sup>                      | Read, interpret, and analyse a wide variety of technical work.                                               |
| 5      | 7 <sup>th</sup> , 8 <sup>th</sup> and 9 <sup>th</sup>    | Conduct independent research and write a 7–10-page research report.                                          |
| 6      | 10 <sup>th</sup> , 11 <sup>th</sup> and 12 <sup>th</sup> | Prepare documents that adhere to manuscript requirements and demonstrate effective proofreading and editing. |

**Rubrics for Evaluation:**

| Criteria               | Excellent                                                            | Good                                                                     | Fair                                                                                       | Poor                                                                                      | Points |
|------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------|
| Clarity & Organization | (25-20)<br>Well-organized, with excellent flow and logical structure | (19-15)<br>Ideas are generally clear and logical but may lack some depth | (14-10)<br>Some clarity, but lacks coherence; ideas may be incomplete or poorly sequenced. | (9-1)<br>Writing is unclear, lacks logical flow; key ideas are hard to follow or missing. | ___/25 |



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|                                                   |                                                                                                                                          |                                                                                                     |                                                                                                                      |                                                                                                                       |                |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----------------|
|                                                   |                                                                                                                                          | or smooth transitions.                                                                              |                                                                                                                      |                                                                                                                       |                |
| Technical Accuracy                                | (20-15)<br>Completely accurate, with no errors; demonstrates excellent technical understanding                                           | (14-10)<br>Generally accurate, with minor errors or omissions; technical understanding is adequate. | (9-5)<br>Some technical errors or misunderstandings; important details may be inaccurate.                            | (4-1) Contains significant errors in technical content or terminology; major concepts are misunderstood.              | ___/20         |
| Language & Style                                  | (15-10)<br>Highly professional, precise, and appropriate language; excellent use of technical vocabulary; no grammar or spelling errors. | (9-6)<br>Appropriate language with minor style inconsistencies; few grammars or spelling errors.    | (5 -3)<br>Language is somewhat appropriate but may be overly casual or informal; several grammars or spelling errors | (2-1) Uses inappropriate or unprofessional language; frequent grammar and spelling errors; lacks technical vocabulary | ___/15         |
| Document Design, Formatting and ethical integrity | (25-20)<br>Exceptionally well-formatted with a professional appearance; document is visually appealing and easy to navigate.             | (19-15)<br>Generally well-formatted with minor inconsistencies; document is readable.               | (14-10) Some formatting issues; headings, fonts, or spacing are inconsistent but still readable.                     | (9-1) Poorly formatted with inconsistent or inappropriate use of headings, fonts, or spacing; difficult to read.      | ___/25         |
| Oral communication / Presentation                 | (15-10)<br>Excellent Communication                                                                                                       | (9-5)<br>Communication is clear                                                                     | (4-3)<br>Unclear communication                                                                                       | (2-1)<br>Unable to communicate                                                                                        | ___/15         |
| <b>Total</b>                                      |                                                                                                                                          |                                                                                                     |                                                                                                                      |                                                                                                                       | <b>___/100</b> |

**Note:** The project will be evaluated for 100 marks and reduced to 50 marks.

**SEE Exam (50 Marks):**

Work carried out by students will be evaluated by external examiner along with internal faculty.



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|                      |                          |                             |           |
|----------------------|--------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>3</b>                 |                             |           |
| <b>Course Title:</b> | <b>Assembly Language</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS3AEASL</b>        | <b>Total Contact Hours:</b> | <b>30</b> |
| <b>L-T-P:</b>        | <b>0-0-1</b>             | <b>Total Credits:</b>       | <b>1</b>  |

**Guidelines:**

- This course focuses on developing comprehensive skills in programming in assembly language, understanding how a computer works instead of developing large programs and learning the underlying principles for generating compact machine code.
- The process of learning assembly language involves writing non-trivial programs to perform specific low-level actions including arithmetic operations, function calls, using stack-dynamic local variables, and operating system interaction for activities such as input/output. Under this project work, student should develop Assembly language programs using 8086 Instruction Set.
- Students can form a group with minimum of two and maximum of four.
- Teacher allotted for project work to students should teach the basics of 8086 architecture and instruction set to the students.

**Reference Text Books:**

| <b>Sl. No</b> | <b>Book Title</b>                                                   | <b>Authors</b>                 | <b>Edition</b>  | <b>Publisher</b>           | <b>Year</b> |
|---------------|---------------------------------------------------------------------|--------------------------------|-----------------|----------------------------|-------------|
| 1             | Advanced Microprocessor and peripherals                             | A K Ray,<br>K M Bhurchandi     | 3 <sup>rd</sup> | Tata McGraw-Hill Education | 2012        |
| 2             | Advanced Microprocessors and IBM - PC Assembly Language Programming | Udaya Kumar,<br>B. Uma Shankar | 1 <sup>st</sup> | McGraw Hill Education      | 2017        |

**Tutorial Links:**

1. <https://www.coursera.org/learn/introduction-iot-boards>
2. <https://www.mygreatlearning.com/academy/learn-for-free/courses/arduino-vs-raspberry-pi>
3. <https://www.shiksha.com/online-courses/free-iot-and-connected-devices-courses-certification-training-st563-tg949?regFlow=N>

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Course Outcomes (COs):**

|            |                                                                                                                         |
|------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply knowledge of architecture, instruction set and assembly language programming of microprocessor to solve problems. |
| <b>CO2</b> | Analyse the given problem and select appropriate interrupts                                                             |
| <b>CO3</b> | Design and develop programs using 8086 instruction set architecture                                                     |

**CO-PO-PSO mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     |     | 3   |     |     | 2   |     |     |     |      |      |      |      |      |
| CO3 |     |     |     |     | 3   |     |     | 2   | 2   | 2    |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                            | Remarks             | Marks |
|---------------------------------|---------------------|-------|
| Internals                       | ---                 | ---   |
| Quiz                            | ---                 | ---   |
| Lab Component                   | CIE through Reviews | 50    |
| Alternate Assessment Tool (AAT) | ---                 | ---   |
| Total                           |                     | 50    |

**Weekly Activities and Delivery:**

| Sl. No. | Week            | Activity                                           | Content deliverables by the assigned teacher                                             | Technologies/Skills to be Covered                                                        |
|---------|-----------------|----------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1       | 1 <sup>st</sup> | Introduction to Assembly programming               | Introducing 8086 Architecture                                                            | Covering all the Architectural details of the 8086 Microprocessor.                       |
| 2       | 2 <sup>nd</sup> | Introduction to basic instruction set Architecture | Instructions like data transfer instructions and Arithmetic instructions to be delivered | Writing basic programs using like data transfer instructions and Arithmetic instructions |
| 3       | 3 <sup>rd</sup> | Introduction of program control structures         | Branch and loop instructions to be covered                                               | Writing basic programs using Branch and loop instructions                                |
| 4       | 4 <sup>th</sup> | Introduction of String instructions                | Formats of all string instructions to be delivered                                       | Writing and analysing basic programs using strings                                       |

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|   |                                     |                                                                                  |                                                                                                                       |                                                                                                                  |
|---|-------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| 5 | 5 <sup>th</sup>                     | Formation of groups and selection of problem                                     | Set of problems to be shared with the students and provide them with various complex concepts of Assembly programming | Students are asked to come up with a problem and choose any one of the advanced concept to implement the project |
| 6 | 6 <sup>th</sup> and 7 <sup>th</sup> | Advanced architectural concepts. Design of the problem selected                  | Stacks and procedures. Review of the design of the problem                                                            | Usage of stacks and procedures in their problem                                                                  |
| 7 | 8 <sup>th</sup> and 9 <sup>th</sup> | Introduction to interrupts and their usage. Implementation of the problem        | Interrupts. Review of implementation of the problem                                                                   | Usage of Interrupts                                                                                              |
| 8 | 10 <sup>th</sup>                    | Incorporating ISA and advanced concepts in design and development of the problem | Review of the implementation of the entire problem                                                                    | Complete problem implementation                                                                                  |

**Rubrics for Evaluation:**

| Criteria                                                                 | Excellent                                                                                           | Good                                                                                        | Satisfactory                                                                                        | Needs Improvement                                                                          | Points |
|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------|
| Understanding the architecture of the microprocessor and instruction set | (20-16)<br>Clearly exhibits the knowledge of architecture of the microprocessor and instruction set | (15-10)<br>Exhibits the knowledge of architecture of the microprocessor and instruction set | (9-5)<br>Partially able to Understanding the architecture of the microprocessor and instruction set | (4-0)<br>Fails to Understanding the architecture of the microprocessor and instruction set | ___/20 |
| Apply and analyse the ISA to solve basic problems                        | (20-16)<br>Exemplary knowledge in applying and analysis of ISA to solve the problems                | (15-10)<br>Good knowledge in applying and analysis of ISA to solve the problems             | (9-5)<br>Moderate knowledge in applying and analysis of ISA to solve the problems .                 | (4-0)<br>Inadequate knowledge in applying and analysis of ISA to solve the problems        | ___/20 |
| Develop the solution to the problem using architectural concepts and ISA | (20-16)<br>Exceptional good in developing a solution using assembly language                        | (15-10)<br>Competent enough in developing a solution using assembly language                | (9-5)<br>Moderately develops a solution using assembly language                                     | (4-0)<br>Poor in developing a solution using assembly language                             | ___/20 |



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|                        |                                                                                                                                              |                                                                                    |                                                                                |                                                                               |                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------|
| Group Participation    | (10-9)<br>Exhibits active engagement, exceptional collaboration, and effective teamwork throughout the project lifecycle.                    | (8-6)<br>Consistent participation and constructive collaboration within the group. | (5-3)<br>Minimal but noticeable participation and occasional contributions.    | (2-0)<br>Lack of active participation and collaboration in the group.         | ___/10         |
| Presentation           | (10-9)<br>Professional, engaging presentation with outstanding visuals and comprehensive content, demonstrating exceptional delivery skills. | (8-6)<br>Well-structured presentation with clear content and effective delivery.   | (5-3)<br>Basic presentation with some structure and varying delivery quality.  | (2-0)<br>Disorganized presentation lacking in coherence and adequate content. | ___/10         |
| Report & Documentation | (20-16)<br>Comprehensive report covering all project aspects with meticulous documentation                                                   | (15-10)<br>Well-structured report with detailed coverage of project implementation | (9-5)<br>Basic report with limited content, covering essential project details | (4-0)<br>Poorly structured and incomplete report, lacking essential details   | ___/20         |
| <b>Total</b>           |                                                                                                                                              |                                                                                    |                                                                                |                                                                               | <b>___/100</b> |

**Note:** The project will be evaluated for 100 marks and reduced to 50 marks.

**SEE Exam (50 Marks):**

Projects carried out by students will be evaluated by External examiner along with an Internal faculty.



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# **4<sup>th</sup>**

# **Semester**



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|                      |                                        |                             |           |
|----------------------|----------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>4</b>                               |                             |           |
| <b>Course Title:</b> | <b>Linear Algebra and Optimization</b> |                             |           |
| <b>Course Code:</b>  | <b>23MA4BSLAO</b>                      | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P</b>         | <b>2-1-0</b>                           | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                              | <b>Hours</b> |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1               | <b>CONTINUOUS OPTIMIZATION – 1</b><br>Local and global optima, convex sets and functions separating hyperplanes, application of Hessian matrix in optimization, Optimization using gradient descent/ascent and NR method.                                                                                                                  | 8            |
| 2               | <b>CONTINUOUS OPTIMIZATION-2</b><br>Sequential search 3-point search and Fibonacci search. Constrained Optimization, Method of Lagrange multipliers, duality, KKT optimality conditions.                                                                                                                                                   | 8            |
| 3               | <b>INNER PRODUCT SPACES</b><br>Inner products, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt orthogonalization process, QR-factorization, least squares problem and least square error. Curve fitting – Principle of least squares, fitting a straight line and fitting a parabola. | 9            |
| 4               | <b>EIGENVALUES AND EIGENVECTORS</b><br>Introduction, Polynomials of Matrices, Cayley-Hamilton Theorem, eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form.                                                                                                           | 8            |
| 5               | <b>MATRIX DECOMPOSITION AND THEIR APPLICATIONS</b><br>Diagonalization, Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, signature, index, Singular value decomposition, Dimensional reduction – PCA.                                                                                        | 9            |

**Prescribed Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                   | <b>Authors</b>                                 | <b>Edition</b>  | <b>Publisher</b>  | <b>Year</b> |
|----------------|-------------------------------------|------------------------------------------------|-----------------|-------------------|-------------|
| 1              | Linear Algebra and its applications | David C. Lay, Steven R. Lay, Judi J Mc. Donald | 6 <sup>th</sup> | Pearson Education | 2021        |
| 2              | Linear Algebra and its Applications | Gilbert Strang                                 | 4 <sup>th</sup> | Brooks Cole       | 2005        |
| 3              | Linear Algebra: An Introduction     | Richard Bronson & Gabriel B. Costa             | 2 <sup>nd</sup> | Academic press    |             |



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**Reference Text Books:**

| Sl. No. | Book Title                                                      | Authors                                                   | Edition         | Publisher                  | Year |
|---------|-----------------------------------------------------------------|-----------------------------------------------------------|-----------------|----------------------------|------|
| 1       | Schaum's outline series - Theory and problems of linear algebra | Seymour Lipschutz, Marc Lipson                            | 6 <sup>th</sup> | McGraw-Hill Education      | 2017 |
| 2       | Linear Algebra and Optimization for Machine Learning            | Charu C. Aggarwal                                         |                 | Springer                   | 2020 |
| 3       | Linear Algebra                                                  | Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence | 5 <sup>th</sup> | Pearson                    | 2019 |
| 4       | Mathematics for Machine learning                                | Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong     |                 | Cambridge University Press | 2020 |

**E-books and online course materials:**

1. <https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm>
2. <https://www.math.ucdavis.edu/~linear/linear.pdf>

**Online Courses and Video Lectures:**

1. <https://www.coursera.org/learn/linear-algebra-machine-learning>
2. <https://nptel.ac.in/syllabus/111106051/>

**Course Outcomes (CO's):**

|            |                                                                                                         |
|------------|---------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concepts of linear algebra in Computer and Allied Engineering Sciences.                       |
| <b>CO2</b> | Demonstrate the applications of computer science and Allied Engineering Science using modern ICT tools. |

**CO-PO-PSO mapping:**

|            | PO1      | PO2 | PO3 | PO4 | PO5      | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|----------|-----|-----|-----|----------|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | <b>3</b> |     |     |     |          |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> | <b>3</b> |     |     |     | <b>3</b> |     |     |     |     |      |      |      |      |      |



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**Assessment Tool Plan:**

| Tool         | Remarks | Marks     |
|--------------|---------|-----------|
| Quiz         | 10      | 5         |
| AAT          | 10      | 5         |
| Test 1       | 40      | 20        |
| Test 2       | 40      | 20        |
| <b>Total</b> |         | <b>50</b> |



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|                      |                     |                             |           |
|----------------------|---------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>4</b>            |                             |           |
| <b>Course Title:</b> | <b>Cryptography</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS4ESCRP</b>   | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P</b>         | <b>3-0-0</b>        | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                     | <b>Hours</b> |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1               | <p><b>Introduction:</b> Security Goals, Cryptographic Attacks.</p> <p><b>Mathematics of Cryptography:</b> Integer Arithmetic, Modular Arithmetic, Linear Congruence.</p> <p><b>Traditional symmetric-Key Ciphers:</b> Introduction, Substitution Ciphers, Transposition Ciphers.</p> <p><b>Mathematics of Symmetric-key cryptography:</b> Algebraic Structures, GF (<math>2^n</math>) Fields.</p> | 8            |
| 2               | <p><b>Introduction to Modern Symmetric Key Ciphers:</b> Modern Block Ciphers, Modern Stream Ciphers.</p> <p><b>Data Encryption Standard (DES):</b> Introduction, DES Structure, DES Analysis, Security of DES, Multiple DES.</p> <p><b>Advanced Encryption Standard (AES):</b> Introduction, Transformations, Key Expansion, AES Ciphers, analysis of AES.</p>                                    | 9            |
| 3               | <p><b>Encipherment using Modern Symmetric-Key Ciphers:</b> Use of Modern Block Ciphers, Use of Stream Ciphers.</p> <p><b>Mathematics of Asymmetric-Key Cryptography:</b> Primes, Primality Testing, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation and Logarithm.</p>                                                                                                            | 9            |
| 4               | <p><b>Asymmetric -Key Cryptography:</b> Introduction, RSA cryptosystem, ElGamal Cryptosystem, Elliptic Curve cryptosystems. Cryptographic hash functions, SHA-512.</p>                                                                                                                                                                                                                            | 8            |
| 5               | <p><b>Message Integrity and Message Authentication:</b> Message authentication, Digital Signature, RSA digital signature.</p> <p><b>Key Management:</b> KERBEROS, Diffie-Hellman Key Agreement, X.509</p>                                                                                                                                                                                         | 8            |



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**Prescribed Text Book:**

| Sl. No. | Book Title                        | Authors                                   | Edition         | Publisher        | Year |
|---------|-----------------------------------|-------------------------------------------|-----------------|------------------|------|
| 1       | Cryptography and Network Security | Behrouz A. Forouzan, Debdeep Mukhopadhyay | 2 <sup>nd</sup> | Tata McGraw Hill | 2013 |

**Reference Text Books:**

| Sl. No. | Book Title                                                | Authors      | Edition         | Publisher              | Year |
|---------|-----------------------------------------------------------|--------------|-----------------|------------------------|------|
| 1       | Cryptography: Theory and Practice                         | Stinson. D.  | 3 <sup>rd</sup> | Chapman & Hall/CRC     | 2012 |
| 2       | Cryptography and Network Security                         | Atul Kahate  | 1 <sup>st</sup> | Tata McGraw-Hill       | 2003 |
| 3       | Cryptography and Network Security Principles and practice | W. Stallings | 5 <sup>th</sup> | Pearson Education Asia | 2013 |

**E-Books:**

| Sl. No. | Book Title                                                 | Authors                       | Edition         | Publisher         | Year | URL                                                                                             |
|---------|------------------------------------------------------------|-------------------------------|-----------------|-------------------|------|-------------------------------------------------------------------------------------------------|
| 1       | Cryptography and Network Security: Principles and Practice | William Stallings             | 3 <sup>rd</sup> | Pearson Education | 2007 | <a href="http://williamsallings.com/Crypto3e.html">http://williamsallings.com/Crypto3e.html</a> |
| 2       | Handbook of Applied Cryptography                           | Menez, Van Oorschot, Vanstone | 1 <sup>st</sup> | CRC Press         | 2001 | <a href="http://www.ca.cr.math.uwaterloo.ca/hac/">http://www.ca.cr.math.uwaterloo.ca/hac/</a>   |

**MOOC Courses:**

| Sl. No. | Course name                       | Course Offered By | Year | URL                                                                                         |
|---------|-----------------------------------|-------------------|------|---------------------------------------------------------------------------------------------|
| 1       | Cryptography and Network Security | NPTEL             | 2017 | <a href="http://nptel.ac.in/courses/106105031/">http://nptel.ac.in/courses/106105031/</a>   |
| 2       | Cryptography I                    | Coursera          | 2019 | <a href="https://www.coursera.org/course/crypto">https://www.coursera.org/course/crypto</a> |



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**Course Outcomes (COs):**

|            |                                                                                                    |
|------------|----------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply cryptographic techniques to ensure data confidentiality, integrity, and authentication       |
| <b>CO2</b> | Analyze various symmetric and asymmetric cryptosystems and types of attacks on these cryptosystems |
| <b>CO3</b> | Demonstrate cryptographic encryption and decryption techniques                                     |

**CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |     | 2   |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> |     |     |     |     | 3   |     |     | 2   | 2   |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                                   | Remarks            | Marks     |
|----------------------------------------|--------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b> |
| <b>Quiz</b>                            | --                 | --        |
| <b>Lab Component</b>                   | --                 | --        |
| <b>Self-Study Component</b>            | --                 | --        |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>         | <b>10</b> |
| <b>Total</b>                           |                    | <b>50</b> |

**AAT Plan:**

Students are supposed to develop a Cryptographic algorithm/Digital Signature (using C/C++ preferably) without using libraries or built-in functions. Code demonstration along with a report has to be submitted.

Example: Implement of RSA Digital Signature, Elgamal Digital Signature, Diffie Hellman Signature, Modified RSA algorithm for practical purpose, Hybrid encryption schemes

| Sl. No | Week                                | Activity                                                        |
|--------|-------------------------------------|-----------------------------------------------------------------|
| 1      | 1 <sup>st</sup>                     | Formation of groups. Note: Student groups of size 2 members.    |
| 2      | 2 <sup>nd</sup> and 3 <sup>rd</sup> | AAT topic selection by each group                               |
| 3      | 4 <sup>th</sup>                     | Presentation: Student team and topic introduction by each group |



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|   |                                     |                                                                                     |
|---|-------------------------------------|-------------------------------------------------------------------------------------|
| 4 | 5 <sup>th</sup>                     | Design the workflow along with Front-end Design                                     |
| 5 | 6 <sup>th</sup> and 7 <sup>th</sup> | Presentation on Front-end Design of the application                                 |
| 6 | 8 <sup>th</sup> and 9 <sup>th</sup> | Design and Development of the actual algorithm and testing it for various test case |
| 7 | 10 <sup>th</sup>                    | Design and Development of the actual algorithm and testing it for various test case |
| 8 | 11 <sup>th</sup>                    | Complete code demonstration                                                         |
| 9 | 12 <sup>th</sup>                    | AAT Report Preparation                                                              |

**Rubrics used for evaluation:**

| Criteria                                           | Exemplary                                                                                                                                | Proficient                                                                                                                              | Partially Proficient                                                                                                                        | Points |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------|
| User Interface / Front End Design or Tool usage.   | (4)<br>The designed application has an exceptional design, attractive and usable interface. It is easy to locate all important elements. | (3-2)<br>The designed application has an attractive design and usable interface. It is easy to locate all important elements. Elements. | (1-0)<br>The designed application has a usable design interface, but may appear busy or boring. It is easy to locate most of the important. | ___/4  |
| Algorithm<br>OR<br>Implementation done in the Tool | (12-9)<br>Implementation of the algorithm has been done accurately without the usage of any library functions.                           | (8-5)<br>Implementation of the algorithm has been done appropriately without the usage of any library functions.                        | (4-0)<br>Implementation of the algorithm has been done with usage of few library functions.                                                 | ___/12 |
| Implementation                                     | (8-7)<br>Correct implementation of the algorithm with appropriate data structures.                                                       | (6-4)<br>Correct implementation of algorithm.                                                                                           | (3-0)<br>Algorithm is not implemented in accordance with the design.                                                                        | ___/ 8 |



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|                                   |                                                                                                     |                                                                                                                              |                                                                                                            |               |
|-----------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|---------------|
| Testing for various cases         | (4)<br>The implemented algorithm works for any given valid input.                                   | (3-2)<br>The implemented algorithm works for almost all valid inputs.                                                        | (1-0)<br>The implemented algorithm works for any some valid inputs.                                        | ___/4         |
| Application/Relevance             | (4)<br>The designed algorithm has several applications and is relevant in the area of cryptography. | (3-2)<br>The designed algorithm has few applications and is relevant in the area of cryptography.                            | (1-0)<br>The designed algorithm has few applications and is not very relevant in the area of cryptography. | ___/4         |
| Report                            | (4)<br>Clear and Effective writing and adherence to appropriate style guidelines                    | (3-2)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines | (1-0)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines  | ___/4         |
| Oral communication (presentation) | (4)<br>Clear and effective communication                                                            | (3-2)<br>Communication is clear                                                                                              | (1-0)<br>Unclear communication                                                                             | ___/4         |
| <b>Total</b>                      |                                                                                                     |                                                                                                                              |                                                                                                            | <b>___/40</b> |

Note: AAT will be evaluated for 40 marks and reduced to 10 marks.



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|                      |                                                |                             |           |
|----------------------|------------------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>4</b>                                       |                             |           |
| <b>Course Title:</b> | <b>Theoretical Foundations of Computations</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS4PCTFC</b>                              | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>2-1-0</b>                                   | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                | <b>Hours</b> |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Introduction to Finite Automata:</b><br>Central Concepts of Automata Theory, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Finite Automata with Epsilon Transition, An Application Text Search.                                                                                                                                                                            | <b>5</b>     |
| <b>2</b>        | <b>Regular Expressions and Languages:</b><br>Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Proving Languages Not to Be Regular, Closure Properties of Regular Languages, Equivalence and Minimization of Automata                                                                                                                                       | <b>5</b>     |
| <b>3</b>        | <b>Context Free Grammars and Languages Parse Trees:</b><br>Context Free Grammars, Parse trees, Applications of Context Free Grammars, Ambiguity in Grammars and Languages, Eliminating Useless Symbols, Computing the Generating and Reachable Symbols, Eliminating Epsilon Productions, Eliminating Unit Productions, Chomsky Normal Form, Greibach Normal form                                             | <b>6</b>     |
| <b>4</b>        | <b>Pushdown Automata:</b><br>Definition of the Pushdown Automaton, The Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata, The Pumping Lemma for Context Free Languages, Closure Properties of Context Free Languages                                                                                                                                                       | <b>6</b>     |
| <b>5</b>        | <b>Introduction to Turing Machine:</b><br>Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Restricted Turing Machines, Turing Machines and Computers, Definition of Post's Correspondence Problem, A Language That Is Not Recursively Enumerable, An Undecidable Problem That is RE, Other Undecidable Problems | <b>6</b>     |



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**Prescribed Text Book:**

| Sl. No. | Book Title                                                 | Authors                                             | Edition         | Publisher | Year |
|---------|------------------------------------------------------------|-----------------------------------------------------|-----------------|-----------|------|
| 1       | Introduction to Automata Theory, Languages and Computation | John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman | 3 <sup>rd</sup> | Pearson   | 2007 |

**Reference Text Books:**

| Sl. No. | Book Title                                       | Authors       | Edition         | Publisher               | Year |
|---------|--------------------------------------------------|---------------|-----------------|-------------------------|------|
| 1       | Introduction to Languages and Automata Theory    | John C Martin | 3 <sup>rd</sup> | Tata McGraw-Hill        | 2007 |
| 2       | An Introduction to formal Languages and Automata | Peter Linz    | 5 <sup>th</sup> | Narosa publishing house | 2012 |

**E-Book:**

| Sl. No. | Book Title                            | Authors                       | Edition         | Publisher           | Year | URL                                                                                                                                                       |
|---------|---------------------------------------|-------------------------------|-----------------|---------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Introduction to Theory of Computation | Anil Maheshwari, Michiel Smid | 1 <sup>st</sup> | Carleton University | 2019 | <a href="https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf">https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf</a> |

**MOOC Courses:**

| Sl. No. | Course name                                         | Course Offered By   | Year | URL                                                                                                                                                 |
|---------|-----------------------------------------------------|---------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Automata Theory                                     | Edx                 | 2022 | <a href="https://www.edx.org/course/automata-theory">https://www.edx.org/course/automata-theory</a>                                                 |
| 2       | Introduction to Automata, Languages and Computation | NPTEL               | 2022 | <a href="https://onlinecourses.nptel.ac.in/noc21_cs19/preview">https://onlinecourses.nptel.ac.in/noc21_cs19/preview</a>                             |
| 3       | Automata Theory                                     | Stanford University | 2022 | <a href="https://online.stanford.edu/courses/soe-ycautomata-automata-theory">https://online.stanford.edu/courses/soe-ycautomata-automata-theory</a> |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Course Outcomes (COs):**

|            |                                                                                                                          |
|------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the knowledge of Automata Theory, Grammars & Regular Expressions for the given requirement of the formal language. |
| <b>CO2</b> | Analyse the given Automata to identify the formal language it represents.                                                |
| <b>CO3</b> | Design Automata and Grammar for pattern recognition and syntax checking of the given formal language.                    |

**CO-PO-PSO mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5      | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|----------|----------|----------|-----|----------|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | <b>3</b> |          |          |     |          |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |          | <b>2</b> |          |     |          |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> |          |          | <b>2</b> |     | <b>3</b> |     |     |     |     |      |      |      |      |      |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>     | <b>Marks</b> |
|----------------------------------------|--------------------|--------------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b>    |
| <b>Quiz</b>                            | -                  | -            |
| <b>Lab Component</b>                   | ---                | ---          |
| <b>Alternate Assessment Tool (AAT)</b> | <b>ONE</b>         | <b>10</b>    |
| <b>Total</b>                           |                    | <b>50</b>    |

**AAT Plan**

Students are required to design, simulate, and analyse formal language models using JFLAP. They must demonstrate concepts such as DFA, NFA, PDA, CFG, and Turing Machines, validate strings, analyse correctness, and submit a technical report and presentation.

**Rubrics used for AAT evaluation:**

| Sl. No. | Evaluation Criterion                                   | Related Weeks / Activities                                        | Excellent                                                               | Good                         | Satisfactory          | Needs Improvement  | Marks |
|---------|--------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------|-----------------------|--------------------|-------|
| 1       | Participation & Orientation                            | Weeks 1–2: Group formation, orientation, understanding objectives | Actively participated; clear understanding of objectives and tool usage | Participated with minor gaps | Minimal participation | Poor participation | 2     |
| 2       | Understanding of Basic Automata Concepts & JFLAP Usage | Week 3: Basics of automata & JFLAP                                | Demonstrates strong conceptual clarity and confident JFLAP usage        | Concepts mostly clear        | Basic understanding   | Weak understanding | 3     |

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| Sl. No. | Evaluation Criterion                                  | Related Weeks / Activities | Excellent                                                                     | Good                           | Satisfactory        | Needs Improvement         | Marks |
|---------|-------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------|--------------------------------|---------------------|---------------------------|-------|
| 3       | Design & Simulation of DFA/NFA and NFA→DFA Conversion | Week 4                     | Correct and efficient automata designs; correct conversions                   | Minor design/conversion errors | Partial correctness | Incorrect or incomplete   | 3     |
| 4       | Advanced Automata Design (RE, PDA, TM)                | Weeks 5–6                  | Correct design & simulation of RE, PDA, and TM with explanation               | Designs mostly correct         | Limited correctness | Poor or incorrect designs | 4     |
| 5       | Problem Selection & Mini Application Design           | Weeks 7–10                 | Realistic, relevant problem; appropriate automata model selected              | Relevant but simple problem    | Generic problem     | Poor or copied problem    | 3     |
| 6       | Analysis, Validation & Optimization                   | Week 11                    | Clear interpretation, error handling, optimization, and theory justification  | Good analysis with minor gaps  | Limited analysis    | No meaningful analysis    | 2     |
| 7       | Report Quality & Documentation                        | Week 12                    | Well-structured report with theory, design steps, screenshots, and test cases | Good documentation             | Basic documentation | Poor or incomplete        | 2     |
| 8       | Final Demonstration & Explanation                     | Week 12                    | Confident demonstration and clear explanation of working                      | Adequate demonstration         | Limited explanation | Unable to explain         | 1     |

Note: AAT will be evaluated for 20 marks and reduced to 10 marks



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|                      |                          |                             |           |
|----------------------|--------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>4</b>                 |                             |           |
| <b>Course Title:</b> | <b>Operating Systems</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS4PCOPS</b>        | <b>Total contact hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-1</b>             | <b>Total Credits:</b>       | <b>4</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Hours</b> |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <p><b>Introduction:</b> Computer-System Architecture, Operating System Structure, Operating system operations.</p> <p><b>System Structures:</b> Operating system services, User and Operating system interface, System Calls, Types of System calls, System programs, Operating System Structure</p> <p><b>Process Concept:</b> Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication.</p> | <b>9</b>     |
| <b>2</b>        | <p><b>Multithreaded Programming:</b> Overview, Multi-core Programming, Multithreading Models, Implicit Threading, Threading Issues.</p> <p><b>Process Scheduling:</b> Basic concepts, Scheduling Criteria, Scheduling Algorithms. Thread Scheduling, Multiple-Processor Scheduling, Real-Time CPU Scheduling.</p>                                                                                                              | <b>8</b>     |
| <b>3</b>        | <p><b>Synchronization:</b> Background, Critical Section Problem, Mutex locks, Semaphores, Classic Problems of Synchronization</p> <p><b>Deadlocks:</b> System Model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock Detection and Recovery from deadlock.</p>                                                                                                    | <b>8</b>     |
| <b>4</b>        | <p><b>Memory management strategies:</b> Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table</p> <p><b>Virtual Memory Management:</b> Background, Demand paging, copy on write, Page replacement algorithms, Allocation of frames, Thrashing.</p>                                                                                                                                 | <b>9</b>     |
| <b>5</b>        | <p><b>Implementing File-system:</b> File-System Structure, File-System Implementation, Directory Implementation, Allocation methods, Free-space management.</p> <p><b>Mass-storage structure:</b> Disk Structure, Disk Attachment, Disk Scheduling.</p> <p><b>System Protection:</b> Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix.</p>                  | <b>8</b>     |



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**Prescribed Text Book:**

| Sl. No. | Book Title                | Authors                                             | Edition         | Publisher               | Year |
|---------|---------------------------|-----------------------------------------------------|-----------------|-------------------------|------|
| 1       | Operating System Concepts | Abraham Silberschatz, Peter Baer Galvin, Greg Gagne | 9 <sup>th</sup> | John Wiley & Sons, Inc. | 2012 |

**Reference Text Books:**

| Sl. No. | Book Title                                                      | Authors             | Edition         | Publisher     | Year |
|---------|-----------------------------------------------------------------|---------------------|-----------------|---------------|------|
| 1       | Modern Operating System                                         | Andrew S. Tanenbaum | 3 <sup>rd</sup> | Prentice Hall | 2007 |
| 2       | Operating System: Internals and Design Principles               | William Stallings   | 8 <sup>th</sup> | Prentice Hall | 2014 |
| 3       | Schaum's Outline of Operating Systems (Schaum's Outline Series) | J. Archer Harris    | 1 <sup>st</sup> | McGraw-Hill   | 2020 |

**E-Books:**

| Sl. No. | Book Title                            | Authors           | Edition         | Publisher                      | Year | URL                                                                                                                                                     |
|---------|---------------------------------------|-------------------|-----------------|--------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Operating Systems Guide               | Tim Bower         | 1 <sup>st</sup> | Kansas State Polytechnic       | 2009 | <a href="https://infonw.laurensstcoop.nl/">https://infonw.laurensstcoop.nl/</a>                                                                         |
| 2       | Operating Systems Course Notes        | Dr. John T.Bell   | 9 <sup>th</sup> | University of Illinois Chicago | 2013 | <a href="https://www.cs.uic.edu/~jbell/CourseNotes/OpeOperatingSyst/index.htm">https://www.cs.uic.edu/~jbell/CourseNotes/OpeOperatingSyst/index.htm</a> |
| 3       | Schaum's Outline of Operating Systems | J. Archer Harris. | 1 <sup>st</sup> | McGraw-Hill                    | 2002 | <a href="https://archive.org/details/schaumsoutlineof0000harr">https://archive.org/details/schaumsoutlineof0000harr</a>                                 |

**MOOC Courses:**

| Sl. No. | Course name                      | Course offered by | Year | URL                                                                                                                               |
|---------|----------------------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------------|
| 1       | Introduction to operating system | Coursera          | 2024 | <a href="https://www.coursera.org/courses?query=operating%20system">https://www.coursera.org/courses?query=operating%20system</a> |

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|   |                                  |         |      |                                                                                                                                                             |
|---|----------------------------------|---------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | Introduction to operating system | NPTEL   | 2017 | <a href="https://onlinecourses.nptel.ac.in/noc20_cs75/preview">https://onlinecourses.nptel.ac.in/noc20_cs75/preview</a>                                     |
| 3 | Introduction to operating system | Udacity | 2022 | <a href="https://www.udacity.com/course/introduction-to-operatingsystems--ud923">https://www.udacity.com/course/introduction-to-operatingsystems--ud923</a> |

**Course Outcomes (COs):**

|            |                                                                                     |
|------------|-------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the different concepts and functionalities of Operating System.               |
| <b>CO2</b> | Analyse various Operating system strategies and techniques.                         |
| <b>CO3</b> | Design solutions that incorporate the core functionalities of an Operating System.  |
| <b>CO4</b> | Conduct practical experiments to implement the functionalities of Operating system. |

**CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> |     |     | 3   |     |     |     |     |     |     |      |      |      |      | 3    |
| <b>CO4</b> |     |     |     |     | 3   |     |     | 2   | 2   |      |      |      |      | 3    |

**Assessment Plan for CIE:**

| Tool                                   | Remarks               | Marks     |
|----------------------------------------|-----------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 of 3</b>    | <b>20</b> |
| <b>Quiz</b>                            | -                     | -         |
| <b>Lab Component</b>                   | <b>CIE + Lab test</b> | <b>25</b> |
| <b>Alternate Assessment Tool (AAT)</b> | <b>ONE</b>            | <b>05</b> |
| <b>Total</b>                           |                       | <b>50</b> |

**Laboratory Plan:**

- Students should write the program (pseudocode) for that week to be executed in the lab at the beginning of each lab and get it corrected by the batch-in-charge faculty and then start with the program execution.
- Soft copy (PDF file) of all the programs along with the output needs to be submitted before the lab test.
- Continuous Internal Evaluation for each lab is for 10 marks which includes execution of the program in the allotted lab time and showing the output. Observation book needs to be corrected on the same day itself.

**Note:**

- Student completes the program on the day within the lab timings and shows the output for any given input case: 10 marks



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- Student completes the program on the day within the lab timings and shows the output for only some input cases: 8 marks
  - Student completes the program on the day and shows the output for any given input case: 6 marks
  - Student completes the program on the day within one week and shows the output for any given input case: 4 marks
  - Submission any later: 0 marks
4. One Lab Test will be conducted for all the 10 programs. Lab Test will comprise programs which are completely different from the existing lab list of programs.
5. Marks split up for Lab:

Continuous Internal Evaluation: **100 marks à reduced to 10 marks**

Lab Test: **60 marks à reduced to 15 marks** (Writeup- 15 marks, Execution- 25 marks, Modification asked in the program for execution – 10 marks, Viva- 10 marks)

| Lab Program | Unit # | Marks for Continuous Evaluation | Program Details                                                                                                                                                                                                                                                                                                                            |
|-------------|--------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1           | 1      | 10                              | Write a C program to simulate the following CPU scheduling algorithm to find turnaround time and waiting time. (Any one)<br>a) FCFS<br>b) SJF<br>c) Priority<br>d) Round Robin (Experiment with different quantum sizes for RR algorithm)                                                                                                  |
| 2           | 1      | 10                              | Write a C program to simulate multi-level queue scheduling algorithm considering the following scenario. All the processes in the system are divided into two categories – system processes and user processes. System processes are to be given higher priority than user processes. Use FCFS scheduling for the processes in each queue. |
| 3           | 2      | 10                              | Write a C program to simulate Real-Time CPU Scheduling algorithms: (Any one)<br>a) Rate- Monotonic<br>b) Earliest-deadline First<br>c) Proportional scheduling                                                                                                                                                                             |
| 4           | 3      | 10                              | Write a C program to simulate: (Any one)<br>a) Producer-Consumer problem using semaphores.<br>b) Dining-Philosopher's problem                                                                                                                                                                                                              |



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|    |   |    |                                                                                                                                                               |
|----|---|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5  | 3 | 10 | Write a C program to simulate: (Any one)<br>a) Bankers' algorithm for the purpose of deadlock avoidance.<br>b) Deadlock Detection                             |
| 6  | 4 | 10 | Write a C program to simulate the following contiguous memory allocation techniques. (Any one)<br>a) Worst-fit<br>b) Best-fit<br>c) First-fit                 |
| 7  | 4 | 10 | Write a C program to simulate page replacement algorithms. (Any one)<br>a) FIFO<br>b) LRU<br>c) Optimal                                                       |
| 8  | 5 | 10 | Write a C program to simulate the following file allocation strategies. (Any one)<br>a) Sequential<br>b) Indexed<br>c) Linked                                 |
| 9  | 5 | 10 | Write a C program to simulate the following file organization techniques. (Any one)<br>a) Single level directory<br>b) Two level directory<br>c) Hierarchical |
| 10 | 5 | 10 | Write a C program to simulate disk scheduling algorithms. (Any one)<br>a) FCFS<br>b) SCAN<br>c) SSTF<br>d) c-LOOK                                             |

**AAT**

Programs listed in the above table from 8 to 10 are implemented as a part of AAT, where students will explore the concepts, write the code and do the comparative analysis of the given techniques.



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|                      |                                          |                             |           |
|----------------------|------------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>4</b>                                 |                             |           |
| <b>Course Title:</b> | <b>Analysis and Design of Algorithms</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS4PCADA</b>                        | <b>Total contact hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-1</b>                             | <b>Total Credits:</b>       | <b>4</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Hours</b> |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | Introduction to Algorithm, Fundamentals of Algorithmic Problem Solving.<br><b>Analysis of Algorithm Efficiency:</b> Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-Recursive Algorithms, Mathematical Analysis of Recursive Algorithms.                                                                                                                       | <b>8</b>     |
| <b>2</b>        | <b>Brute-Force:</b> String Matching, Exhaustive Search: Travelling Salesman Problem, Knapsack Problem, Assignment Problem.<br><b>Decrease-and-Conquer:</b> Topological Sorting, Algorithms for Generating Combinatorial Objects: Generating Permutations, Decrease by-a-Constant-Factor Algorithms: Russian Peasant Multiplication, Variable Size-Decrease Algorithms: Computing Median and the Selection Problem. | <b>8</b>     |
| <b>3</b>        | <b>Divide-and-Conquer:</b> Merge Sort, Quicksort, Multiplication of Long Integers and Strassen's Matrix Multiplication.<br><b>Transform-and-Conquer:</b> Presorting, Heaps and Heap sort, Horner's Rule.<br><b>Space and Time Tradeoffs:</b> Horspool's Algorithm, Boyer-Moore Algorithm.                                                                                                                          | <b>9</b>     |
| <b>4</b>        | <b>Dynamic Programming:</b> Coin Problem, The Knapsack Problem, Warshall's Algorithm, Floyd's Algorithms.<br><b>Greedy Technique:</b> Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees, Fractional Knapsack Problem.                                                                                                                                                                     | <b>9</b>     |
| <b>5</b>        | <b>Backtracking:</b> n-Queens Problem, Subset-Sum Problem.<br><b>Branch-and-Bound:</b> Knapsack Problem, Traveling Salesman Problem.<br><b>NP-Completeness:</b> Polynomial time, Polynomial-time verification, NP-completeness and reducibility. NP-Complete Problems: The Clique problem, The Vertex Cover problem.                                                                                               | <b>8</b>     |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Prescribed Text Books:**

| Sl. No. | Book Title                                            | Authors                                                               | Edition         | Publisher | Year |
|---------|-------------------------------------------------------|-----------------------------------------------------------------------|-----------------|-----------|------|
| 1       | Introduction to the Design and Analysis of Algorithms | Anany Levitin                                                         | 3 <sup>rd</sup> | Pearson   | 2014 |
| 2       | Introduction to Algorithms                            | Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein | 3 <sup>rd</sup> | MIT Press | 2009 |

**Reference Text Books:**

| Sl. No. | Book Title                          | Authors                                   | Edition         | Publisher                 | Year |
|---------|-------------------------------------|-------------------------------------------|-----------------|---------------------------|------|
| 1       | Fundamentals of Computer Algorithms | Ellis Horowitz, Satraj Sahn, Rajasekharam | 2 <sup>nd</sup> | University Press Pvt. Ltd | 2009 |
| 2       | Analysis and Design of Algorithms   | Padma Reddy                               | 1 <sup>st</sup> | Sri Nandi Publications    | 2009 |

**E-Book:**

| Sl. No. | Book Title                                                                 | Authors                                            | Edition         | Publisher             | Year | URL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------|----------------------------------------------------------------------------|----------------------------------------------------|-----------------|-----------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Introduction to the Design and Analysis of Algorithms A Strategic Approach | R. C. T. Lee, S. S. Tseng, R. C. Chang, Y. T. Tsai | 1 <sup>st</sup> | McGraw Hill Education | 2005 | <a href="https://dilipbyella.wordpress.com/wp-content/uploads/2021/03/r._c._t._lee_shian-shyong_tseng_ruei-chuan_chang_y._t._tsai_-_introduction_to_the_design_and_analysis_of_algorithms_2006_mcgraw-hill_education__asia_-_libgen.lc1_.pdf">https://dilipbyella.wordpress.com/wp-content/uploads/2021/03/r._c._t._lee_shian-shyong_tseng_ruei-chuan_chang_y._t._tsai_-_introduction_to_the_design_and_analysis_of_algorithms_2006_mcgraw-hill_education__asia_-_libgen.lc1_.pdf</a> |
| 2       | Data Structures and Algorithm Analysis in C++                              | Allen Weiss                                        | 4 <sup>th</sup> | Pearson Education     | 2014 | <a href="https://www.uoitc.edu.iq/images/documents/informatics-institute/Competitive_exam/DataStructures.pdf">https://www.uoitc.edu.iq/images/documents/informatics-institute/Competitive_exam/DataStructures.pdf</a>                                                                                                                                                                                                                                                                 |



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**MOOC Courses:**

| Sl. No. | Course name                       | Course offered by | Year | URL                                                                                                                         |
|---------|-----------------------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------|
| 1       | Design and Analysis of Algorithms | NPTEL             | 2019 | <a href="https://onlinecourses.nptel.ac.in/noc19_cs47/preview">https://onlinecourses.nptel.ac.in/noc19_cs47/preview</a>     |
| 2       | Design and Analysis of Algorithms | Swayam            | 2020 | <a href="https://onlinecourses.swayam2.ac.in/cec20_cs03/preview">https://onlinecourses.swayam2.ac.in/cec20_cs03/preview</a> |

**Course Outcomes (COs):**

|            |                                                                                                    |
|------------|----------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Analyze time complexity of algorithms using asymptotic notations.                                  |
| <b>CO2</b> | Apply various algorithm design techniques for the given problem.                                   |
| <b>CO3</b> | Evaluate the appropriate algorithm/design technique for solving a given problem                    |
| <b>CO4</b> | Conduct practical experiments by applying appropriate algorithm design technique to solve problems |

**CO-PO-PSO- Mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> |     | 2   |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> | 2   |     | 3   |     |     |     |     | 3   | 3   |      |      |      |      |      |
| <b>CO4</b> |     |     | 3   | 3   |     |     |     |     |     |      |      |      |      | 3    |

**Assessment Plan for CIE:**

| Tool                                   | Remarks               | Marks     |
|----------------------------------------|-----------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 of 3</b>    | <b>20</b> |
| <b>Quiz</b>                            | -                     | -         |
| <b>Lab Component</b>                   | <b>CIE + Lab test</b> | <b>25</b> |
| <b>Alternate Assessment Tool (AAT)</b> | <b>ONE</b>            | <b>05</b> |
| <b>Total</b>                           |                       | <b>50</b> |

**Laboratory Plan:**

1. Design, develop and implement the specified algorithms for the following problems using any programming Language in LINUX/Windows environment, preferably using C language.
2. For sorting and searching problems, the program should allow both manual entry of the array elements and also reading of array elements using random number generator. Plot a graph of the time taken versus N using MS Excel and paste the same in the record.
3. Observation book to be maintained for Continuous Internal Evaluation
4. Lab Record–Soft copy of the record.



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5. For the first three lab session the students are to be introduced on the Hacker rank/ Leetcode platform to solve problems.
6. One Lab Test will be conducted for all the 11 programs. Lab test will comprise programs which are completely different from the existing lab list of programs.
7. Marks split up for Lab:

| Lab Program | Marks for Continuous Evaluation | Program Details                                                                                                                                                                                                                                                                                 |
|-------------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1           | 10                              | <ul style="list-style-type: none"><li>• Write program to obtain the Topological ordering of vertices in a given digraph. (5 Marks)</li><li>• LeetCode Program related to Topological sorting. (5 Marks)</li></ul>                                                                               |
| 2           | 10                              | Implement Johnson Trotter algorithm to generate permutations.                                                                                                                                                                                                                                   |
| 3           | 10                              | <ul style="list-style-type: none"><li>• Sort a given set of N integer elements using Merge Sort technique and compute its time taken. Run the program for different values of N and record the time taken to sort. (5 Marks)</li><li>• LeetCode Program related to sorting. (5 Marks)</li></ul> |
| 4           | 10                              | <ul style="list-style-type: none"><li>• Sort a given set of N integer elements using Quick Sort technique and compute its time taken. (5 Marks)</li><li>• LeetCode Program related to sorting. (5 Marks)</li></ul>                                                                              |
| 5           | 10                              | Sort a given set of N integer elements using Heap Sort technique and compute its time taken.                                                                                                                                                                                                    |
| 6           | 10                              | <ul style="list-style-type: none"><li>• Implement 0/1 Knapsack problem using dynamic programming. (5 Marks)</li><li>• LeetCode Program related to Knapsack problem or Dynamic Programming. (5 Marks)</li></ul>                                                                                  |
| 7           | 10                              | <ul style="list-style-type: none"><li>• Implement All Pair Shortest paths problem using Floyd's algorithm. (5 Marks)</li><li>• LeetCode Program related to shortest distance calculation. (5 Marks)</li></ul>                                                                                   |



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|    |    |                                                                                                                                                                                                                                                           |
|----|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8  | 10 | <ul style="list-style-type: none"> <li>Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm. (5 Marks)</li> <li>Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm. (5 Marks)</li> </ul> |
| 9  | 10 | <ul style="list-style-type: none"> <li>Implement Fractional Knapsack using Greedy technique. (5 Marks)</li> <li>LeetCode Program related to Greedy Technique algorithms. (5 Marks)</li> </ul>                                                             |
| 10 | 10 | From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.                                                                                                                                      |
| 11 | 10 | Implement "N-Queens Problem" using Backtracking.                                                                                                                                                                                                          |

**AAT Plan:**

Students have to solve the 5 coding challenges assigned to them. The problems will be chosen from the LeetCode platform covering the concepts covered in class. They will have to present their solutions in a team of 2 and also submit a report.

**Rubrics used for AAT evaluation:**

| Criteria                 | Exemplary                                                                                         | Proficient                                                                              | Partially Proficient                                            | Points  |
|--------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------|
| Implementation           | (8-7)<br>Correct implementation of the problem assigned with appropriate data structures.         | (6-4)<br>Correct implementation of problem assigned.                                    | (3-0)<br>Code is not implemented in accordance with the design. | ___ / 8 |
| Time complexity analysis | (5-4)<br>Manually derived the time complexity and analyse the same as per the output of the code. | (3-2)<br>Manually derived the time complexity but not bale to analyze through the code. | (1-0)<br>Not able to manually derive the time complexity.       | ___ / 4 |



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|                                     |                                                                              |                                                                                                |                                                                               |         |
|-------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|---------|
| Oral communication/<br>presentation | (5-4)<br><br>Clear and effective communication.<br>Answers all the questions | (3-2)<br><br>Communication is clear.<br><br>Answered most of the questions                     | (1-0)<br><br>Unclear communication.<br><br>Answered only few of the questions | ___ / 4 |
| Report                              | (5-4)<br><br>Clear and Effective writing and adherence to syntax.            | (3-2)<br><br>Writing that is clear and effective for the most part and minor errors in syntax. | (1-0)<br><br>Unclear and ineffective writing and multiple errors in syntax.   | ___/4   |
| Total                               |                                                                              |                                                                                                |                                                                               | ___/20  |

Note: AAT will be evaluated for 20 marks and reduced to 5 marks.



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|                      |                             |                             |           |
|----------------------|-----------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>4</b>                    |                             |           |
| <b>Course Title:</b> | <b>Software Engineering</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS4PCSED</b>           | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                | <b>Total Credits:</b>       | <b>3</b>  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Hours |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction:</b> FAQs about software engineering, FAQ's Continued, Professional and ethical responsibility, Software Process models, Process Iteration, Process Iteration continued, Process Activities, Software requirements: Functional and Non-functional requirements, User requirements, System requirements, Interface specification, The software requirements document.                                                                                                                                                             | 8     |
| 2        | <b>Requirements engineering process:</b> Feasibility studies, Requirement's elicitation and analysis, Requirements validation, Requirements management.<br><br><b>System models:</b> Context models, Behavioural models, Data models, Object models, Structured methods.                                                                                                                                                                                                                                                                         | 8     |
| 3        | <b>Architectural Design:</b> Architectural Design Decisions, System organization Modular Decomposition styles, Control styles<br><b>Object oriented design:</b> Objects and Object Classes, An object-oriented design process Design evolution.                                                                                                                                                                                                                                                                                                  | 8     |
| 4        | <b>Software Project Management:</b> The Management Spectrum, Product, process and project, The W5HH principle, Critical practices, Estimation for Software Project: Software Project estimation, Decomposition Techniques, Empirical Estimation models<br><br><b>Project Scheduling:</b> Basic Concepts, Project Scheduling, Defining Task set and Task network, Scheduling<br><br><b>Risk Management:</b> Reactive versus proactive strategies, Software Risks, Risk identification, Risk mitigation, monitoring and management, The RMMM plan. | 9     |
| 5        | <b>Rapid software development:</b> Agile methods, Extreme programming, Rapid application development<br><br><b>Software evolution:</b> Legacy system evolution<br><br><b>Verification and Validation:</b> Planning verification and validation, Software inspections, Automated static analysis, Verification and formal methods<br><br><b>Software testing:</b> System testing, Component testing, Test case design, Test automation.                                                                                                           | 9     |



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**Prescribed Text Books:**

| Sl. No. | Book Title                                     | Authors           | Edition         | Publisher         | Year |
|---------|------------------------------------------------|-------------------|-----------------|-------------------|------|
| 1.      | Software Engineering                           | Ian Somerville    | 8 <sup>th</sup> | Pearson Education | 2007 |
| 2.      | Software Engineering: A Practitioners Approach | Rogers S Pressman | 7 <sup>th</sup> | McGraw-Hill       | 2007 |

**Reference books:**

| Sl. No. | Book Title                                   | Authors                                 | Edition         | Publisher         | Year |
|---------|----------------------------------------------|-----------------------------------------|-----------------|-------------------|------|
| 1       | Software Engineering theory and Practice     | Shari Lawrence Pflieger, Joanne M Atlec | 3 <sup>rd</sup> | Pearson Education | 2006 |
| 2       | Software Engineering Principles and Practice | Waman S Jawadekar                       | 1 <sup>st</sup> | Tata McGraw Hill  | 2004 |

**E-Books:**

| Sl. No. | Book Title                                      | Authors          | Edition         | Publisher        | Year | URL                                                                                                                                                                                                                                                                         |
|---------|-------------------------------------------------|------------------|-----------------|------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Fundamentals of Software Engineering            | Rajib Mall       | 4 <sup>th</sup> | PHI              | 2014 | <a href="https://davcollegetitilagarh.org/wp-content/uploads/2020/09/fundamentals-of-software-engineering-fourth-edition-rajib-mall.pdf">https://davcollegetitilagarh.org/wp-content/uploads/2020/09/fundamentals-of-software-engineering-fourth-edition-rajib-mall.pdf</a> |
| 2       | Software Engineering: A practitioner's Approach | Roger.S.Pressman | 7 <sup>th</sup> | Tata McGraw Hill | 2010 | <a href="https://www.mlsu.ac.in/econtents/16_EBOOK-7th_ed_software_engineering_a_practitioners_approach_by_roger_s_pressman.pdf">https://www.mlsu.ac.in/econtents/16_EBOOK-7th_ed_software_engineering_a_practitioners_approach_by_roger_s_pressman.pdf</a>                 |
| 3       | An Integrated approach to Software Engineering  | Pankaj Jalote    | 3 <sup>rd</sup> | Springer         | 2005 | <a href="https://www.academia.edu/4660479/an_integral_approach_to_software_engineering_BY_PANKAJ_JALOTE">https://www.academia.edu/4660479/an_integral_approach_to_software_engineering_BY_PANKAJ_JALOTE</a>                                                                 |



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**MOOC Courses:**

| Sl. No. | Course name                                    | Course Offered By | Year | URL                                                                                                                                                                       |
|---------|------------------------------------------------|-------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.      | Software development process and methodologies | Coursera          | 2020 | <a href="https://www.coursera.org/learn/software-processes">https://www.coursera.org/learn/software-processes</a>                                                         |
| 2.      | Foundations of Software Testing and validation | Coursera          | 2022 | <a href="https://www.coursera.org/learn/foundations-of-software-testing-and-validation">https://www.coursera.org/learn/foundations-of-software-testing-and-validation</a> |
| 3.      | Software Engineering                           | Swayam            | 2019 | <a href="https://swayam.gov.in/nd1_noc19_cs69/preview">https://swayam.gov.in/nd1_noc19_cs69/preview</a>                                                                   |

**Course Outcomes (COs):**

|            |                                                                                                                              |
|------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply Software Engineering design techniques and practices for developing a software                                         |
| <b>CO2</b> | Analyze the various requirements, design and testing techniques to select the appropriate techniques for the software system |
| <b>CO3</b> | Design models for different phases of software development to solve real world problems.                                     |
| <b>CO4</b> | Manage projects by estimating cost and time required for developing the software product                                     |

**CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 3   |     |     |     |     |     |     |     |     |      |      | 3    |      |      |
| <b>CO2</b> |     | 3   |     |     |     |     |     |     |     |      |      | 3    |      |      |
| <b>CO3</b> |     |     | 3   |     |     |     |     |     |     |      |      | 3    |      |      |
| <b>CO4</b> |     |     |     |     |     |     | 2   | 2   | 2   | 2    |      | 3    |      |      |

**Assessment Plan for CIE:**

| Tool                                   | Remarks            | Marks     |
|----------------------------------------|--------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b> |
| <b>Quiz</b>                            | <b>One</b>         | <b>05</b> |
| <b>Lab Component</b>                   | ---                | ---       |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>         | <b>05</b> |
| <b>Total</b>                           |                    | <b>50</b> |

**AAT Plan:**

The students are supposed to select any real-world problem and they have to develop the following:



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- a. Software Requirements Specification (Functional, non-functional and domain requirements)
- b. Software Architecture (Context model, Structural and Control model to be followed with diagrams)
- c. Detailed design (Use case diagram, sequence and state/data flow diagrams considering any one scenario)
- d. Software Estimation and Schedule (Cost and effort estimation and time-line chart)
- e. Test case design (for any 3 scenarios)

Students need to do the presentation and submit a report in the prescribed format.

| Sl. No | Week                                                  | Activity                                                              |
|--------|-------------------------------------------------------|-----------------------------------------------------------------------|
| 1      | 1 <sup>st</sup>                                       | Formation of groups. Note: Student groups of size 3 to 4 members only |
| 2      | 2 <sup>nd</sup>                                       | AAT topic selection by each group                                     |
| 3      | 3 <sup>rd</sup>                                       | Presentation: Student team and topic introduction by each group       |
| 4      | 4 <sup>th</sup> , 5 <sup>th</sup> and 6 <sup>th</sup> | Software Requirement Specification development                        |
| 5      | 7 <sup>th</sup> , 8 <sup>th</sup> and 9 <sup>th</sup> | Designing different models                                            |
| 6      | 10 <sup>th</sup>                                      | Software Cost and Effort Estimation                                   |
| 7      | 11 <sup>th</sup>                                      | Test Case Design                                                      |
| 8      | 12 <sup>th</sup>                                      | AAT Report Preparation                                                |

**Rubrics used for Evaluation:**

| Criteria                                                        | Exemplary                                                                                    | Proficient                                                                                  | Partially Proficient                                                                   | Points |
|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|--------|
| Problem Statement and Software Requirements Specification (SRS) | (4-3)<br>problem statement and software requirements are well defined and complete           | (2-1)<br>problem statement and software requirements are partially complete                 | (1-0)<br>problem statement and software requirements are not complete                  | ___/4  |
| Design                                                          | (4-3)<br>Able to develop complete use case, Context, State and Sequence diagrams for the SRS | (2-1)<br>Able to develop partial use case, Context, State and Sequence diagrams for the SRS | (1-0)<br>Develop incomplete use case, Context, State and Sequence diagrams for the SRS | ___/4  |



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|                                  |                                                                                    |                                                                                                                              |                                                                                                           |               |
|----------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------|
| Test Cases                       | (4-3)<br>All Test cases are identified and well defined                            | (2-1)<br>Some Test cases are identified and well defined                                                                     | (1-0)<br>Unable to identify Test case                                                                     | ___/4         |
| Oral communication(Presentation) | (4-3)<br>Clear and effective communication<br>Answers all the questions            | (2-1)<br>Communication is clear<br>Answered most of the questions                                                            | (1-0)<br>Unclear communication<br>Answered only few of the questions                                      | ___/4         |
| Report                           | (4-3)<br>Clear and Effective writing and adherence to appropriate style guidelines | (2-1)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines | (1-0)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines | ___/4         |
| <b>Total</b>                     |                                                                                    |                                                                                                                              |                                                                                                           | <b>___/20</b> |



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|                      |                               |                             |           |
|----------------------|-------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>4</b>                      |                             |           |
| <b>Course Title:</b> | <b>Universal Human Values</b> |                             |           |
| <b>Course Code:</b>  | <b>22MA4AEUHV</b>             | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-1-0</b>                  | <b>Total Credits:</b>       | <b>1</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Hours</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <p><b>Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</b></p> <ol style="list-style-type: none"> <li>1. Purpose and motivation for the course, recapitulation from Universal Human Values-I</li> <li>2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration</li> <li>3. Continuous Happiness and Prosperity- A look at basic Human Aspirations</li> <li>4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority</li> <li>5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario</li> <li>6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.</li> </ol> <p>Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.</p> | <b>7</b>     |
| <b>2</b>        | <p><b>Understanding Harmony in the Human Being - Harmony in Myself!</b></p> <ol style="list-style-type: none"> <li>1. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’</li> <li>2. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility</li> <li>3. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)</li> <li>4. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’</li> <li>5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail</li> <li>6. Programs to ensure Sanyam and Health.</li> </ol> <p>Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.</p>                                                                                                                                                                       | <b>7</b>     |



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|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>3</b> | <b>Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship</b><br>1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship<br>2. Understanding the meaning of Trust; Difference between intention and competence<br>3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship<br>4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals<br>5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order-from family to world family.<br>Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives | <b>6</b> |
| <b>4</b> | <b>Understanding Harmony in the Nature and Existence - Whole existence as Coexistence</b><br>1. Understanding the harmony in the Nature<br>2. Holistic perception of harmony at all levels of existence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>6</b> |
| <b>5</b> | <b>Implications of the above Holistic Understanding of Harmony on Professional Ethics</b><br>1. Natural acceptance of human values<br>2. Definitiveness of Ethical Human Conduct                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>6</b> |

**Prescribed Text Book:**

| Sl. No. | Book Title                           | Authors                               | Edition         | Publisher   | Year |
|---------|--------------------------------------|---------------------------------------|-----------------|-------------|------|
| 1       | Human Values and Professional Ethics | R R Gaur,<br>R Sangal,<br>G P Bagaria | 1 <sup>st</sup> | Excel Books | 2010 |

**Reference Text Books:**

| Sl. No. | Book Title                 | Authors                                           | Edition         | Publisher                       | Year |
|---------|----------------------------|---------------------------------------------------|-----------------|---------------------------------|------|
| 1       | Jeevan Vidya: Ek Parichaya | A Nagaraj,<br>Jeevan Vidya Prakashan,<br>Amkantak | 1 <sup>st</sup> | Original in Hindi By A. Nagaraj | 1999 |

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|    |                                                                         |                          |                 |                                             |      |
|----|-------------------------------------------------------------------------|--------------------------|-----------------|---------------------------------------------|------|
| 2  | Human Values                                                            | A. N. Tripathi           | 2 <sup>nd</sup> | New Age International (P) Limited           | 2006 |
| 3  | The Story of My Experiments with Truth                                  | Mahatma Gandhi           | 2 <sup>nd</sup> | FP Classics                                 | 2009 |
| 4  | Small is Beautiful                                                      | E F Schumacher           | 1 <sup>st</sup> | Trans Infopreneur Inc                       | 2010 |
| 5  | Slow is Beautiful: New Visions of Community, Leisure, and Joie de Vivre | Cecile Andrews           | 1 <sup>st</sup> | New Society Publishers                      | 2006 |
| 6  | Economy of Permanence                                                   | J C Kumarappa            | 2 <sup>nd</sup> | Sarva Seva Sangh Prakashan                  | 2017 |
| 7  | Bharat Mein Angreji Raj                                                 | PanditSunderlal          | 2 <sup>nd</sup> | Prabhat Prakashan Pvt. Ltd.                 | 2018 |
| 8  | Rediscovering India                                                     | Dharampal                | 1 <sup>st</sup> | Stosius Inc/Advent Books Division           | 1983 |
| 9  | Hind Swaraj or Indian Home Rule                                         | Mohandas K. Gandhi       | 1 <sup>st</sup> | Jitendra T Desai Navajivan Publishing House | 2010 |
| 10 | India Wins Freedom                                                      | Maulana Abdul Kalam Azad | 1 <sup>st</sup> | Orient BlackSwan                            | 1988 |
| 11 | Life of Vivekananda                                                     | Romain Rolland           | 1 <sup>st</sup> | Advaita Ashrama, India                      | 2010 |

**Course Outcomes (COs):**

|            |                                                                                                                                                                                         |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Conduct self-exploration and distinguish between values and skills, happiness and accumulation of physical facilities, the self and the body, Intension and Competence of an individual |
| <b>CO2</b> | Analyze the value of harmonious relationship based on trust and respect in personal and professional life                                                                               |
| <b>CO3</b> | Examine the role of a human being in ensuring harmony in society and nature                                                                                                             |
| <b>CO4</b> | Apply the understanding of ethics in life and profession                                                                                                                                |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7      | PO8      | PO9      | PO10 | PO11     | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|----------|----------|----------|------|----------|------|------|------|
| <b>CO1</b> |     |     |     |     |     |     |          |          |          |      | <b>3</b> |      |      |      |
| <b>CO2</b> |     |     |     |     |     |     |          | <b>3</b> |          |      | <b>3</b> |      |      |      |
| <b>CO3</b> |     |     |     |     |     |     |          |          | <b>2</b> |      | <b>3</b> |      |      |      |
| <b>CO4</b> |     |     |     |     |     |     | <b>3</b> |          |          |      | <b>3</b> |      |      |      |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b> | <b>Marks</b> |
|----------------------------------------|----------------|--------------|
| <b>Internals (Quiz)</b>                | <b>One</b>     | <b>10</b>    |
| <b>Attendance</b>                      | --             | <b>05</b>    |
| <b>Lab Component</b>                   | --             | --           |
| <b>Alternate Assessment Tool (AAT)</b> | <b>Two</b>     | <b>35</b>    |
| <b>Total</b>                           |                | <b>50</b>    |

**AAT Plan:****1. Group Assignment:**

- Evaluation for 30 marks. PFA the rubrics for evaluation.
- Team size: 3-4
- Students should hand write the report. General template to be used.
- Topic chosen should be relevant to UHV course

**2. Individual Assignment:**

- Evaluation for 5 Marks
- Students have to hand write his/her reflections from Unit-1 to Unit-5 w.r.t UHV course. General template to be used.
- Minimum number of pages: Two

| <b>Sl. No</b> | <b>Week</b>                                                                                                  | <b>Activity</b>                                                        |
|---------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1             | 1 <sup>st</sup> and 2 <sup>nd</sup>                                                                          | Formation of groups. Note: Student groups of size 3 to 4 members only. |
| 2             | 3 <sup>rd</sup> and 4 <sup>th</sup>                                                                          | AAT topic selection by each group.                                     |
| 3             | 5 <sup>th</sup> , 6 <sup>th</sup> , 7 <sup>th</sup> , 8 <sup>th</sup> , 9 <sup>th</sup> and 10 <sup>th</sup> | Presentation: Student team and topic introduction by each group.       |
| 4             | 11 <sup>th</sup> and 12 <sup>th</sup>                                                                        | AAT Report Preparation.                                                |



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**Rubrics used for evaluation- AAT (Group Assignment): 30 Marks**

| Criteria                                                                        | Excellent                                                              | Good                                                                       | Average                                                                        | Poor                                                                        | Total         |
|---------------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------|---------------|
| Ability to analyse the values chosen.<br>(Teamwork)                             | (5)<br>Able to analyse the values chosen in detail.                    | (4)<br>Able to analyse most of the qualities of the values chosen.         | (3)<br>Able to analyse few of the qualities of the values chosen.              | (1)<br>Unable to analyse the values chosen in detail.                       | ___/5         |
| Ability to elaborate on the challenges faced of the chosen topic.<br>(Teamwork) | (5)<br>Able to elaborate all the challenges faced of the chosen topic. | (4)<br>Able to elaborate most of the challenges faced of the chosen topic. | (3)<br>Able to elaborate on a few of the challenges faced of the chosen topic. | (1)<br>Unable to elaborate any of the challenges faced of the chosen topic. | ___/5         |
| Ability to share experiences.<br>(Individual)                                   | (5)<br>Able to share all experiences.                                  | (4)<br>Able to share most experiences.                                     | (3)<br>Able to share a few of the experiences.                                 | (1)<br>Not confident to share any of the experiences.                       | ___/5         |
| Ability to plan for enhancing this value in the society.<br>(Teamwork)          | (5)<br>Able to enhance this value in all aspects of the society.       | (4)<br>Able to enhance this value in most aspects of the society.          | (3)<br>Able to enhance this value in a few aspects of the society.             | (1)<br>Unable to enhance this value in any aspect of the society.           | ___/5         |
| Ability to communicate on chosen topics.<br>(Individual)                        | (5)<br>Able to communicate effectively on the chosen topic.            | (4)<br>Able to communicate moderately on the chosen topic.                 | (3)<br>Able to communicate minimally on the chosen topic.                      | (1)<br>Unable to communicate on the chosen topic.                           | ___/5         |
| Ability to prepare a report.<br>(Individual)                                    | (5)<br>Able to prepare a report in detail.                             | (4)<br>Able to prepare the report moderately.                              | (3)<br>Able to prepare the report with minimal content.                        | (1)<br>Unable to prepare a report appropriately for the chosen topic.       | ___/5         |
| <b>Total</b>                                                                    |                                                                        |                                                                            |                                                                                |                                                                             | <b>___/30</b> |

Note: 1) Group assignment will be evaluated for 30 marks.

2) Individual assignment will be evaluated for 5 marks.



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|                      |                                       |                            |           |
|----------------------|---------------------------------------|----------------------------|-----------|
| <b>Semester:</b>     | <b>4</b>                              |                            |           |
| <b>Course Title:</b> | <b>Mobile Application Development</b> |                            |           |
| <b>Course Code:</b>  | <b>23CS4AEMAD</b>                     | <b>Total Contact hours</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-0-1</b>                          | <b>Total Credits:</b>      | <b>1</b>  |

**Introduction:**

- This practical course engages students in the process of designing and implementing a native mobile app as an extension to a previously developed full stack web application.
- Students will work in teams to design UI/UX using tools like Figma and Sketch, create comprehensive wireframes, and implement the app using React Native or Flutter.
- Teacher allotted for project work to students should teach students technologies like Dart, React, Flutter etc., during Class/Lab hours as per the allotment. Teacher allotted for project work should guide the students in choosing the topic and towards carrying out project work and complete the evaluation of assigned students.

**Reference Text Books:**

| Sl. No | Book Title                                                             | Authors                                  | Edition         | Publisher        | Year |
|--------|------------------------------------------------------------------------|------------------------------------------|-----------------|------------------|------|
| 1      | Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days | Jake Knapp, John Zeratsky, Braden Kowitz | 1 <sup>st</sup> | Simon & Schuster | 2016 |
| 2      | Learning React Native Building Native Mobile Apps with JavaScript      | Bonnie Eisenman                          | 2 <sup>nd</sup> | O'Reilly Media   | 2017 |

**Tutorial Links:**

1. <https://www.youtube.com/playlist?list=PL4cUxeGkcC9jLYyp2Aoh6hcWuxFDX6PBJ>: Flutter for Beginners
2. Complete React Native Developer in 2023: Zero to Mastery [with Hooks]
3. Create High-Fidelity Designs and Prototypes in Figma:  
<https://www.coursera.org/learn/high-fidelity-designs-prototype>

**Course Outcomes (COs):**

|            |                                                                                                          |
|------------|----------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Design and prototype mobile app interfaces, ensuring a user-friendly experience using UI/UX design tools |
| <b>CO2</b> | Develop Mobile Applications using appropriate frameworks and techniques for real world problems          |
| <b>CO3</b> | Prepare documentation and present the implemented solutions as a team                                    |



# BMS COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU Belagavi)

## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CO-PO-PSO mapping:

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 |     |     | 3   |     |     |     |     |     |     |      |      |      | 3    |      |
| CO2 |     |     |     |     | 3   | 2   |     |     |     |      |      |      | 3    |      |
| CO3 |     |     |     |     |     |     |     | 2   | 2   |      |      |      |      |      |

Assessment Plan for CIE:

| Tool                            | Remarks        | Marks |
|---------------------------------|----------------|-------|
| Internals                       | ---            | ---   |
| Quiz                            | ---            | ---   |
| Lab Component                   | CIE [ Reviews] | 50    |
| Alternate Assessment Tool (AAT) | ----           | --    |
| Total                           |                | 50    |

Weekly Activities and Delivery:

| Sl. No | Week                                                    | Activity                                                                                      | Content deliverables by the assigned teacher                                                                                                                                    |
|--------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | 1 <sup>st</sup>                                         | Formation of teams and initial brainstorming sessions.<br>Note: Student groups of size 3 or 4 | Introduction:<br>Overview of the course and objectives.                                                                                                                         |
| 2      | 2 <sup>nd</sup>                                         | Project topic selection by each Group.                                                        | UI/UX Design <ul style="list-style-type: none"> <li>• Training on Figma/Sketch.</li> <li>• Creation of initial design mockups.</li> </ul>                                       |
| 3      | 3 <sup>rd</sup>                                         | Presentation: Student and Project topic introduction by each group                            | Wireframing and Prototyping <ul style="list-style-type: none"> <li>• Development of detailed wireframes.</li> <li>• Creation of interactive prototypes.</li> </ul>              |
| 4      | 4 <sup>th</sup> , 5 <sup>th</sup> and 6 <sup>th</sup>   | Presentation of design layout of the user interfaces and user experiences.                    | Mobile App Development <ul style="list-style-type: none"> <li>• Introduction to React Native/Flutter.</li> <li>• Implementation of the mobile app.</li> </ul>                   |
| 5      | 7 <sup>th</sup> and 8 <sup>th</sup>                     | Presentation on Mobile app by each group                                                      | Testing and Debugging <ul style="list-style-type: none"> <li>• Testing the mobile app for bugs and issues.</li> <li>• Debugging and finalizing the app.</li> </ul>              |
| 6      | 9 <sup>th</sup> , 10 <sup>th</sup> and 11 <sup>th</sup> | Complete Project Work Demonstration by each group                                             | Final Presentation and Evaluation <ul style="list-style-type: none"> <li>• Presentation of the final mobile app.</li> <li>• Peer evaluation and instructor feedback.</li> </ul> |
| 7      | 12 <sup>th</sup>                                        | Project Report Preparation                                                                    |                                                                                                                                                                                 |



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### Rubrics for Project Evaluation:

| Criteria                    | Excellent                                                                                                                                                | Good                                                                                                                                         | Satisfactory                                                                                                                                            | Needs Improvement                                                                                                          | Unsatisfactory                                                                                          | Points |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|--------|
| UI/UX Design                | (16-14)<br>Designs are exceptionally creative and user-friendly, with attention to detail. All elements are consistent and align with the app's purpose. | (13-11)<br>Designs are well thought out and user-friendly but may lack some creativity or attention to detail.                               | (10)<br>Designs meet the basic requirements but may be inconsistent or lack user-friendliness.                                                          | (9-6)<br>Designs are incomplete or not user-friendly, with significant inconsistencies or errors.                          | (5-0)<br>Little to no effort shown in designs, or designs are entirely missing or unusable.             | ___/16 |
| Wireframing and Prototyping | (18-14)<br>Wireframes and prototypes are comprehensive, detailed, and clearly demonstrate all functionalities and connections.                           | (13-11)<br>Wireframes and prototypes are mostly complete with some details missing or unclear.                                               | (10)<br>Basic wireframes and prototypes are provided, but many details are missing or unclear.                                                          | (9-6)<br>Wireframes and prototypes are incomplete or poorly executed.                                                      | (5-0)<br>Little to no effort shown in wireframes and prototypes, or they are entirely missing.          | ___/18 |
| Mobile App Implementation   | (36-30)<br>The mobile app is fully implemented with excellent functionality, user experience, and code quality.                                          | (29-26)<br>The mobile app is mostly implemented with good functionality and user experience, but there may be some issues with code quality. | (25-20)<br>The mobile app is partially implemented with basic functionality and user experience, and there may be significant issues with code quality. | (19-12)<br>The mobile app is poorly implemented, with numerous issues in functionality, user experience, and code quality. | (11-0)<br>Little to no effort shown in the mobile app implementation, or it is entirely non-functional. | ___/36 |
| Teamwork and Collaboration  | (10)<br>Everyone works well together, actively contributes, and communicates.                                                                            | (9-8)<br>The team generally works well together with some good contributions and                                                             | (7-5)<br>The team works together, but contributions and communication                                                                                   | (4-2)<br>The team struggles to work together, with few contributions and poor                                              | (1-0)<br>The team does not work well together, with no contributions                                    | ___/10 |



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|                            |                                                                                                         |                                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                   |         |
|----------------------------|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------|
|                            | es<br>effectively.                                                                                      | communicati<br>on                                                                                 | n are<br>inconsistent.                                                                            | communicati<br>on.                                                                                    | or<br>communicati<br>on.                                                                                          |         |
| Presentation               | (10)<br>The presentation is clear, engaging, and well-organized, with great use of visuals.             | (9-8)<br>The presentation is mostly clear, with good organization and some use of visuals.        | (7-5)<br>The presentation is okay but could be more organized, and visuals are used minimally.    | (4-2)<br>The presentation is unclear, disorganized, and lacks effective use of visuals.               | (1-0)<br>The presentation is completely unclear, disorganized, and does not use visuals.                          | ___/10  |
| Report & Documentati<br>on | (10)<br>The report is comprehensive, well-structured, and covers all aspects of the project thoroughly. | (9-8)<br>The report covers most of the project aspects in detail and is generally well-organized. | (7-4)<br>The report covers the basic aspects of the project but may lack detail and organization. | (3-2)<br>The report does not adequately cover the project, with poor organization and lack of detail. | (1-0)<br>The report fails to cover the project, lacks any clear structure, and is missing most required sections. | ___/10  |
| <b>Total</b>               |                                                                                                         |                                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                   | ___/100 |

**Note:** The project will be evaluated for 100 marks and reduced to 50 marks.



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|                      |                     |                             |           |
|----------------------|---------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>4</b>            |                             |           |
| <b>Course Title:</b> | <b>UI/UX Design</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS4AEUIX</b>   | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-0-1</b>        | <b>Total Credits:</b>       | <b>1</b>  |

**Guidelines:**

- This course aims to equip learners with in-depth skills in User Interface (UI) and User Experience (UX) design, highlighting their importance in creating seamless and engaging interactions between users and digital platforms.
- Under this project work, student should wireframe and prototype the software application using UI/UX design tools such as Figma.
  - Part 1: Create a Figma design for the website that was developed in the previous semester.
  - Part 2: Design the mobile application in Figma and develop its front-end using Flutter.
- Students can form a group with a minimum of three and maximum of four.
- Teacher allotted for project work should guide students in choosing any UI/UX design tools like Figma, Sketch, etc., help in navigating the project work and complete the evaluation of assigned students.

**Topics to be covered:**

FOUNDATIONAL ELEMENTS OF UI/UX: User Interface - The Relationship Between UI and UX - Roles in UI/UX - A Brief Historical Overview of Interface. Formal Elements of Interface Design - Design Before Design - Look and Feel - Language as a design tool - Active Elements of Interface Design - Static to Active - Functionality - Speed and Style - Composition and Structure - Composing the Elements of Interface Design

USER EXPERIENCE DESIGN FOUNDATIONS: Ideation, Articulation, Development - Planning, Testing, Researching, Mapping - Mapping Content -Mapping Interaction -Non-Visual Paper Prototyping - Non-Visual User Testing -Look and Feel/Visual Research. What Goes Where: Getting real: Wireframes and Interfaces - Nielsen's Usability Heuristics - Consistency and Details - Wireframe Map - Visual Direction - Developing UI- Refining UI.

WEB DESIGN: STRATEGIES AND INFORMATION ARCHITECTURE: The User Experience Process - User-centric design - The UX Phases - Waterfall vs. Agile - Web vs. App. Determining Strategy: User Research - Inspiration - Analytics - User Needs and Client Needs - Target Audience - What is in and What is Out: Outlining Scope - Content and Functionality. The Sitemap: Introduction to Sitemaps - Information Architecture - Sitemap Concerns - annotated process - Elements - Treejack Introduction - Treejack Analysis

WEB DESIGNS: WIRE FRAMES TO PROTOTYPES: Introduction to Wireframes - Responsive Design: Introduction and Primary navigation - Secondary and utility navigation - Related content, inline links, indexes, and search - Wayfinding - Common Form Elements - Homepage Content Strategies - Examples of Homepage Content Strategies - Wireframing Tools.

The Mockup Phase: Visual Mockups - Design Principles - Using whitespace to style a form - Web Fonts - Web Typography: Creating Visual Mockups. Putting it all Together: Clickable Prototypes -

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Invision - Exporting Assets - Importing Assets and Creating Hotspots - Hotspot Templates Sample capstone projects that can be done by students.

**Reference Text Books:**

| Sl. No | Book Title                                                                                                                | Authors                         | Edition         | Publisher  | Year |
|--------|---------------------------------------------------------------------------------------------------------------------------|---------------------------------|-----------------|------------|------|
| 1      | Data Structures using CA<br>Project Guide to UX Design:<br>For User Experience Designers<br>in the Field or in the Making | Russ Unger,<br>Carolyn Chandler | 3 <sup>rd</sup> | New Riders | 2023 |
| 2      | The Elements of User<br>Experience                                                                                        | Jesse James<br>Garrett          | 2 <sup>nd</sup> | New Riders | 2010 |

**MOOC Courses / Tutorial Links:**

1. <https://www.codecademy.com/learn/intro-to-ui-ux>
2. <https://www.mygreatlearning.com/academy/learn-for-free/courses/ui-ux>
3. <https://www.shiksha.com/online-courses/free-ui-ux-design-courses-certification-training305tg1267>
4. <https://www.udemy.com/topic/user-experience-design/free/>

**Course Outcomes (COs):**

|            |                                                                         |
|------------|-------------------------------------------------------------------------|
| <b>CO1</b> | Apply the user interface design to solve real-world problems.           |
| <b>CO2</b> | Design wireframe and prototype of software using UI/UX tools.           |
| <b>CO3</b> | Demonstrate teamwork and problem-solving skills in project development. |

**CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 3   |     |     |     | 3   |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |     |     | 3   |     | 3   | 2   |     |     |     |      |      | 3    | 3    |      |
| <b>CO3</b> |     |     |     |     |     |     |     | 3   | 2   |      |      |      |      |      |



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### **Assessment Plan for CIE:**

| <b>Tool</b>          | <b>Remarks</b>             | <b>Marks</b> |
|----------------------|----------------------------|--------------|
| <b>Internals</b>     | --                         | --           |
| <b>Quiz</b>          | --                         | --           |
| <b>AAT</b>           | --                         | --           |
| <b>Lab Component</b> | <b>CIE through Reviews</b> | <b>50</b>    |
| <b>Total</b>         | <b>50</b>                  |              |

### **Weekly Activities and Delivery:**

|         |                                                                                                           |                                              |                                                                                                                                                                                                                                      |
|---------|-----------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Formation of groups. Note: Student groups of size 2 to 4                                                  | Introduction to UI/UX design                 | Overview of UI/UX design using Figma too                                                                                                                                                                                             |
| 2       | Project topic selection by each Group. Presentation: Student and Project topic introduction by each group | Conceptualizing a software application       | Identifying problem and understanding social and environmental issues. Brainstorming and planning prototype of the application focused on a chosen social/environmental issue. Tools for wireframing and prototyping (Figma, Sketch) |
| 3,4,5,6 | Design Layout of the application in both web based and mobile application.                                | Guiding Prototype                            | Define layouts based on project scope and objectives of the application interfaces.                                                                                                                                                  |
| 7,8,9   | Design and Development of connecting among different designed pages/layouts                               | Wireframe, Figma                             | Development of the project with guidance and a mid-term review to assess progress.                                                                                                                                                   |
| 10      | Presentation by each group                                                                                | Integrating Feedback & Refining Applications | Applying feedback from the midterm review and refining the prototype for better UI design, User testing and UX improvements.                                                                                                         |
| 11      | Complete Project Work Demonstration by each group                                                         | Final Project Presentations and Submissions  | Students present their completed projects and submit their final work for assessment                                                                                                                                                 |
| 12      | Project Report Preparation                                                                                |                                              |                                                                                                                                                                                                                                      |



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**Rubrics for Project Evaluation:**

| Criteria                           | Excellent                                                                                                                                            | Good                                                                                   | Satisfactory                                                                                 | Needs Improvement                                                                                            | Points |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------|
| <b>Review 1</b>                    |                                                                                                                                                      |                                                                                        |                                                                                              |                                                                                                              |        |
| Problem Identification & Relevance | (15-12)<br>Clearly articulates a significant social/environmental issue with insightful, innovative solutions.                                       | (11-8)<br>Recognizes a pertinent issue and offers practical solutions                  | (7-5)<br>Identifies a basic issue with standard solutions.                                   | (4-0)<br>Fails to identify a relevant issue or solution.                                                     | ___/15 |
| Design                             | (15-12)<br>The Mobile application and website is well described and navigation is very smooth.                                                       | (11-8)<br>The Mobile application and website design is average and navigation is good. | (7-5)<br>The Mobile application or website design is average and contains very few features. | (4-0)<br>Design of only mobile application or website is available and it is structured in a very basic way. | ___/15 |
| User Experience & Interface        | (20-15)<br>Exceptional UI/UX design, prioritizing intuitiveness and user-friendliness, with a professional standard of execution                     | (14-10)<br>Competent UI design focused on usability and functionality                  | (9-5)<br>Basic UI design encompassing essential functions and user needs.                    | (4-0)<br>Poor or nonfunctional user interface, lacking in usercentricity                                     | ___/20 |
| <b>Review 2</b>                    |                                                                                                                                                      |                                                                                        |                                                                                              |                                                                                                              |        |
| Technical Implementation           | (20-15)<br>Exemplary implementation of UI/UX design in mobile application and web site, showcasing efficiency, scalability, and technical excellence | (14-10) Reliable and proficient technical performance , meeting key objectives.        | (9-5) Basic implementation incorporating essential features and functionalities.             | (4-0)<br>Inadequate or incomplete technical implementation.                                                  | ___/20 |



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|                        |                                                                                                                                          |                                                                                 |                                                                              |                                                                            |                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------|
| Group Participation    | (10-8) Exhibits active engagement, exceptional collaboration, and effective teamwork throughout the project lifecycle                    | (7-6) Consistent participation and constructive collaboration within the group. | (5-3) Minimal but noticeable participation and occasional contributions      | (2-0) Lack of active participation and collaboration in the group.         | ___/10         |
| Presentation           | (10-8) Professional, engaging presentation with outstanding visuals and comprehensive content, demonstrating exceptional delivery skills | (7-6) Wellstructured presentation with clear content and effective delivery.    | (5-3) Basic presentation with some structure and varying delivery quality.   | (2-0) Disorganized presentation lacking in coherence and adequate content. | ___/10         |
| Report & Documentation | (10-8) Comprehensive report covering all project aspects with meticulous documentation, including methodology, design, and future scope. | (7-6) Wellstructured report with detailed coverage of project implementation.   | (5-3) Basic report with limited content, covering essential project details. | (2-0) Poorly structured and incomplete report, lacking essential details.  | ___/10         |
| <b>Total</b>           |                                                                                                                                          |                                                                                 |                                                                              |                                                                            | <b>___/100</b> |

**Note:** The project will be evaluated for 100 marks and reduced to 50 marks.



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|                      |                                  |                             |           |
|----------------------|----------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>4</b>                         |                             |           |
| <b>Course Title:</b> | <b>Hardware Interface Design</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS4AEHID</b>                | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-0-1</b>                     | <b>Total Credits:</b>       | <b>1</b>  |

**Guidelines:**

- This course aims for the students to gain the necessary knowledge to construct Hardware based applications and use software services for processing and storage of the data produced by the hardware devices
- Under this project work, Students will gain practical experience in the development of Hardware based applications while providing exposure to appropriate hardware and software platforms that require such development.
- Students can form a group with minimum of two and maximum of three.
- Teacher allotted for project work to students should teach architecture of the hardware board and the related components like sensors, actuators and communication modules Teacher allotted for project work should guide the students in choosing the topic and towards carrying out project work and complete the evaluation of assigned students.

**Reference Text Books:**

| <b>Sl. No</b> | <b>Book Title</b>                                                | <b>Authors</b>                | <b>Edition</b>  | <b>Publisher</b>                 | <b>Year</b> |
|---------------|------------------------------------------------------------------|-------------------------------|-----------------|----------------------------------|-------------|
| 1             | Internet of Things: A Hands-On Approach                          | Arsheep Bahga, Vijay Madiseti | 1 <sup>st</sup> | Orient Blackswan Private Limited | 2015        |
| 2             | Arduino Applied: Comprehensive Projects for Everyday Electronics | Neil Cameron                  | 1 <sup>st</sup> | Apress                           | 2019        |

**Tutorial Links:**

1. <https://www.coursera.org/learn/introduction-iot-boards>
2. <https://www.mygreatlearning.com/academy/learn-for-free/courses/arduino-vs-raspberry-pi>
3. <https://www.shiksha.com/online-courses/free-iot-and-connected-devices-courses-certification-training-st563-tg949?regFlow=N>



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**Course Outcomes (COs):**

|            |                                                                                                                 |
|------------|-----------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the various open-source components to solve real world Problem                                            |
| <b>CO2</b> | Design Intelligent systems using development board by interfacing sensors, communication modules and actuators. |
| <b>CO3</b> | Demonstrate the working of the application for various real time problems.                                      |

**CO-PO-PSO mapping:**

|            | PO1      | PO2 | PO3      | PO4 | PO5      | PO6      | PO7 | PO8      | PO9      | PO10 | PO11 | PSO1 | PSO2     | PSO3 |
|------------|----------|-----|----------|-----|----------|----------|-----|----------|----------|------|------|------|----------|------|
| <b>CO1</b> | <b>3</b> |     |          |     |          |          |     |          |          |      |      |      |          |      |
| <b>CO2</b> |          |     | <b>3</b> |     | <b>3</b> | <b>2</b> |     |          |          |      |      |      | <b>3</b> |      |
| <b>CO3</b> |          |     |          |     |          |          |     | <b>3</b> | <b>3</b> |      |      |      |          |      |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>             | <b>Marks</b> |
|----------------------------------------|----------------------------|--------------|
| <b>Internals</b>                       | ---                        | ---          |
| <b>Quiz</b>                            | ---                        | ---          |
| <b>Lab Component</b>                   | <b>CIE through Reviews</b> | <b>50</b>    |
| <b>Alternate Assessment Tool (AAT)</b> | ---                        | ---          |
| <b>Total</b>                           |                            | <b>50</b>    |

**Weekly Activities and Delivery:**

| <b>Week</b>     | <b>Activity</b>                                                                                              | <b>Content deliverables by the assigned teacher</b>           | <b>Technologies/Skills to be Covered</b>                                                                                                                                                                                                                                                        |
|-----------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 <sup>st</sup> | Formation of groups.<br>Note:<br>Student groups of size 2 or 3                                               | Introduction to Embedded Systems and Architectural components | <ul style="list-style-type: none"> <li>• Overview of any development board.</li> </ul>                                                                                                                                                                                                          |
| 2 <sup>nd</sup> | Project topic selection by each Group.<br>Presentation: Student and Project topic introduction by each group | Conceptualizing an application                                | <ul style="list-style-type: none"> <li>• Identifying problem and understanding its hardware implementation</li> <li>• Brainstorming and planning prototype of the application and required hardware components.</li> <li>• Hardware and software tools required to implement project</li> </ul> |



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|                                                                                  |                                                                                                     |                                                                  |                                                                                                                                                         |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 <sup>rd</sup> ,<br>4 <sup>th</sup> , 5 <sup>th</sup><br>and<br>6 <sup>th</sup> | Design Layout of the application                                                                    | Prototype                                                        | <ul style="list-style-type: none"> <li>Connecting hardware components and testing the functionalities based on project scope and objectives.</li> </ul> |
| 7 <sup>th</sup> , 8 <sup>th</sup><br>and<br>9 <sup>th</sup>                      | Design and Development of the complete hardware and integrating with software for final application | Insight to relevant Sensors, actuators and communication modules | <ul style="list-style-type: none"> <li>Development of the project with guidance and a mid-term review to assess progress.</li> </ul>                    |
| 10 <sup>th</sup>                                                                 | Presentation by each group                                                                          | Integrating Feedback & Refining Applications                     | <ul style="list-style-type: none"> <li>Applying feedback from the mid-term review and refining the prototype for better final application</li> </ul>    |
| 11 <sup>th</sup>                                                                 | Complete Project Work Demonstration by each group                                                   | Final Project Presentations and Submissions                      | <ul style="list-style-type: none"> <li>Students present their completed projects and submit their final work for assessment.</li> </ul>                 |
| 12 <sup>th</sup>                                                                 | Project Report Preparation                                                                          | --                                                               | --                                                                                                                                                      |

**Rubrics for Project Evaluation:**

| Criteria                                                  | Excellent                                                                                                                           | Good                                                                          | Satisfactory                                                                                                               | Needs Improvement                                                        | Points |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|--------|
| Problem Identification & Relevance                        | (20-16)<br>Clearly articulates a significant real time problems offers a innovative Hardware solutions.                             | (15-10)<br>Recognizes a pertinent issue and offers practical solutions.       | (9-5)<br>Identifies a basic issue with available solutions.                                                                | (4-0)<br>Fails to identify a relevant issue or solution.                 | ___/20 |
| Technical Implementation and usage of hardware components | (20-16)<br>Exemplary implementation using various Hardware Components showcasing efficiency, scalability, and technical excellence. | (15-10)<br>Reliable usage of some Hardware Components meeting key objectives. | (9-5)<br>Basic implementation using limited using Hardware Components incorporating essential features and functionalities | (4-0)<br>Inadequate or incomplete usage of the using Hardware Components | ___/20 |



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|                                   |                                                                                                                                                      |                                                                                                         |                                                                                 |                                                                               |                |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------|
| Hardware and Software integration | (20-16)<br>Exceptionally well developed Hardware and software design with complete integrated functional hardware module                             | (15-10)<br>Competent development of Hardware and software design focused on usability and functionality | (9-5)<br>Basic Hardware and software design encompassing essential functions    | (4-0)<br>Poor or non-functional Hardware and software design                  | ___/20         |
| Group Participation               | (10-8)<br>Exhibits active engagement, exceptional collaboration, and effective teamwork throughout the project lifecycle.                            | (7-5)<br>Consistent participation and constructive collaboration within the group.                      | (4-2)<br>Minimal but noticeable participation and occasional contributions.     | (1-0)<br>Lack of active participation and collaboration in the group.         | ___/10         |
| Presentation                      | (10-8)<br>Professional, engaging presentation with outstanding usage and Hardware and software components demonstrating exceptional delivery skills. | (7-5)<br>Well-structured presentation with clear content and effective delivery.                        | (4-2)<br>Basic presentation with some structure and varying delivery quality.   | (1-0)<br>Disorganized presentation lacking in coherence and adequate content. | ___/10         |
| Report & Documentation            | (20-16)<br>Comprehensive report covering all project aspects with meticulous documentation, including methodology, design, and future scope.         | (15-10)<br>Well-structured report with detailed coverage of project implementation.                     | (9-5)<br>Basic report with limited content, covering essential project details. | (9-5)<br>Poorly structured and incomplete report, lacking essential details.  | ___/20         |
| <b>Total</b>                      |                                                                                                                                                      |                                                                                                         |                                                                                 |                                                                               | <b>___/100</b> |



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# **5<sup>th</sup>**

# **Semester**



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|                      |                                  |                             |           |
|----------------------|----------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>                         |                             |           |
| <b>Course Title:</b> | <b>Object Oriented Modelling</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS5PCOOM</b>                | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>2-0-1</b>                     | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                   | <b>Hours</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Class Modeling:</b> Object and class concepts; Link and associations concepts; Generalization and inheritance.<br><b>Advanced Class Modeling:</b> Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages. | <b>6</b>     |
| <b>2</b>        | <b>State Modeling:</b> Events, States, Transitions and Conditions; State diagrams; State diagram behaviour.<br><b>Advanced State Modeling:</b> Nested state diagrams; Nested states; Signal generalization; Concurrency.                                                                                                                        | <b>6</b>     |
| <b>3</b>        | <b>Interaction Modeling:</b> Use case models; Sequence models; Activity models.<br><b>Advanced interaction modeling:</b> Use case relationships; Procedural sequence models; <b>Special constructs for activity models.</b><br><b>System Conception:</b> Devising a system concept; elaborating a concept; preparing a problem statement        | <b>6</b>     |
| <b>4</b>        | <b>Domain Analysis:</b> Overview of analysis; Domain class model; Domain State Model; Domain Interaction Model; Iterating the analysis.<br><b>Application Analysis:</b> Application interaction model; Application class model; Application State Model; Adding operations.                                                                     | <b>5</b>     |
| <b>5</b>        | <b>Design Patterns</b> - Introduction to patterns, Pattern categories; Relationships between patterns; Pattern description.<br><b>Communication Patterns:</b> Forwarder-Receiver; Client-Dispatcher-Server; Publisher-Subscriber.                                                                                                               | <b>5</b>     |

**Prescribed Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                                             | <b>Authors</b>                                                               | <b>Edition</b>  | <b>Publisher</b>    | <b>Year</b> |
|----------------|---------------------------------------------------------------|------------------------------------------------------------------------------|-----------------|---------------------|-------------|
| 1              | Object - Oriented Modeling and Design With UML                | Michael Blaha,<br>James Rumbaugh                                             | 2 <sup>nd</sup> | Pearson Education   | 2007        |
| 2              | Pattern-Oriented Software Architecture, A System of Patterns, | Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal | 1 <sup>st</sup> | John Wiley and Sons | 2007        |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Reference Text Books:**

| Sl. No. | Book Title                                                   | Authors                                                                      | Edition         | Publisher             | Year |
|---------|--------------------------------------------------------------|------------------------------------------------------------------------------|-----------------|-----------------------|------|
| 1       | Pattern-Oriented Software Architecture: A System of Patterns | Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal | 1 <sup>st</sup> | John Wiley and Sons   | 2006 |
| 2       | Object-Oriented Analysis and Design with Applications        | Grady Booch                                                                  | 3 <sup>rd</sup> | Pearson Education     | 2007 |
| 3       | Object-Oriented Analysis, Design and Implementation          | Brahma Dathan, Sarnath Ramnath                                               | 1 <sup>st</sup> | Universities Press    | 2009 |
| 4       | UML 2 Toolkit                                                | Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado                   | 1 <sup>st</sup> | Wiley-dreamtech India | 2004 |

**E-Books:**

| Sl. No. | Book Title                                                   | Authors                                                                      | Edition         | Publisher           | Year | URL                                                                                                                                                                                                                                                         |
|---------|--------------------------------------------------------------|------------------------------------------------------------------------------|-----------------|---------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Pattern-Oriented Software Architecture, A System of Patterns | Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal | 1 <sup>st</sup> | John Wiley and Sons | 2007 | <a href="https://daneshjavi.wordpress.com/wp-content/uploads/2018/02/sznikak_jegyzet_pattern-oriented-sa_vol1.pdf">https://daneshjavi.wordpress.com/wp-content/uploads/2018/02/sznikak_jegyzet_pattern-oriented-sa_vol1.pdf</a>                             |
| 2       | Object Oriented Analysis and Design with Applications        | Grady Booch                                                                  | 3 <sup>rd</sup> | Pearson Edition     | 2005 | <a href="https://zjnu2017.github.io/OOAD/reading/Object.Oriented.Analysis.and.Design.with.Applications.3rd.Edition.by.Booch.pdf">https://zjnu2017.github.io/OOAD/reading/Object.Oriented.Analysis.and.Design.with.Applications.3rd.Edition.by.Booch.pdf</a> |



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|   |                                                     |                                |                 |                    |      |                                                                                                                                 |
|---|-----------------------------------------------------|--------------------------------|-----------------|--------------------|------|---------------------------------------------------------------------------------------------------------------------------------|
| 3 | Object Oriented Analysis, Design and Implementation | Brahma Dathan, Sarnath Ramnath | 2 <sup>nd</sup> | Universities Press | 2009 | <a href="https://link.springer.com/book/10.1007/978-3-319-24280-4">https://link.springer.com/book/10.1007/978-3-319-24280-4</a> |
|---|-----------------------------------------------------|--------------------------------|-----------------|--------------------|------|---------------------------------------------------------------------------------------------------------------------------------|

**MOOC Courses:**

| Sl. No. | Course name                         | Course offered by | Year | URL                                                                                                                         |
|---------|-------------------------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------|
| 1       | Object Oriented analysis and design | NPTEL             | 2024 | <a href="https://archive.nptel.ac.in/courses/106/105/106105153/">https://archive.nptel.ac.in/courses/106/105/106105153/</a> |
| 2       | Object-Oriented Design              | Coursera          | 2024 | <a href="https://www.coursera.org/learn/object-oriented-design">https://www.coursera.org/learn/object-oriented-design</a>   |

**Course Outcomes (COs):**

|            |                                                                                                                      |
|------------|----------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the knowledge of class, State & Interaction Modelling using Unified Modeling Language to solve a given problem |
| <b>CO2</b> | Analyze a System for a given requirement using Unified Modeling language                                             |
| <b>CO3</b> | Design a given system using high level strategy                                                                      |
| <b>CO4</b> | Conduct practical experiment to solve a given problem using Unified Modeling language.                               |

**CO-PO-PSO- Mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5      | PO6      | PO7 | PO8      | PO9      | PO10 | PO11 | PSO1 | PSO2     | PSO3 |
|------------|----------|----------|----------|-----|----------|----------|-----|----------|----------|------|------|------|----------|------|
| <b>CO1</b> | <b>3</b> |          |          |     |          |          |     |          |          |      |      |      |          |      |
| <b>CO2</b> |          | <b>3</b> |          |     |          |          |     |          |          |      |      |      | <b>2</b> |      |
| <b>CO3</b> |          |          | <b>3</b> |     |          |          |     | <b>2</b> | <b>2</b> |      |      |      |          |      |
| <b>CO4</b> |          |          |          |     | <b>3</b> | <b>2</b> |     |          |          |      |      |      |          |      |

**Assessment Plan for CIE:**

| Tool                                   | Remarks               | Marks      |
|----------------------------------------|-----------------------|------------|
| <b>Internals</b>                       | <b>Best 2 of 3</b>    | <b>20</b>  |
| <b>Quiz</b>                            | <b>One</b>            | <b>5</b>   |
| <b>Lab Component</b>                   | <b>CIE + Lab test</b> | <b>25</b>  |
| <b>Alternate Assessment Tool (AAT)</b> | <b>---</b>            | <b>---</b> |
| <b>Total</b>                           |                       | <b>50</b>  |



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**Laboratory Plan:**

**Instructions to the students (Part A & B):**

1. Develop a problem statement.
2. Develop a complete IEEE standard SRS document with several requirements.
3. Identify the conceptual classes and develop a domain model with UML Class diagram.
4. Identify the finite and appropriate states and develop an UML state diagram.
5. Identify Use Cases and develop the Use Case model.
6. Using the identified scenarios find the interaction between objects and represent them using UML Interaction diagrams.
7. Identify the business activities and develop an UML Activity diagram.

| Sl. No.                                                                                                                                                 | Name of the Experiment     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| <b>UML diagrams to be developed are:</b>                                                                                                                |                            |
| 1                                                                                                                                                       | Class Diagram              |
| 2                                                                                                                                                       | Use Case Diagram           |
| 3                                                                                                                                                       | Sequence Diagram           |
| 4                                                                                                                                                       | State Diagram              |
| 5                                                                                                                                                       | Activity Diagram           |
| <b>PART-A</b>                                                                                                                                           |                            |
| <b>Applications Problems to be considered:</b>                                                                                                          |                            |
| 1                                                                                                                                                       | Hotel Management System    |
| 2                                                                                                                                                       | Credit Card Processing     |
| 3                                                                                                                                                       | Library Management System  |
| 4                                                                                                                                                       | Stock Maintenance System   |
| 5                                                                                                                                                       | Passport Automation System |
| <b>PART-B</b>                                                                                                                                           |                            |
| <b>Mini Project: Students must select a problem statement from Smart India Hackathon and must prepare SRS and design UML diagrams (With Simple UI).</b> |                            |



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|                      |                                           |                             |           |
|----------------------|-------------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>                                  |                             |           |
| <b>Course Title:</b> | <b>Data Exploration and Visualization</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS5PCDEV</b>                         | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>2-1-0</b>                              | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Hours</b> |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Introduction to Exploratory Data Analysis (EDA)</b> - Steps in EDA, Data Types: Numerical Data - Discrete data, continuous data - Categorical data - Measurement Scales: Nominal, Ordinal, Interval, Ratio - Comparing EDA with classical and Bayesian Analysis - Software tools for EDA.                                                                                                                                                                                                                                                                                                                                            | <b>5</b>     |
| <b>2</b>        | <b>Transformation Techniques:</b> Performing data deduplication - replacing values - Discretization and binning. Introduction to Missing data, handling missing data: Traditional methods - Maximum Likelihood Estimation.                                                                                                                                                                                                                                                                                                                                                                                                              | <b>5</b>     |
| <b>3</b>        | <b>Descriptive Statistics:</b> Understanding statistics, Measures of central tendency, Measures of dispersion, Grouping Datasets Understanding groupby(), Groupby mechanics, Data aggregation, Pivot tables and cross-tabulations, Correlation: Introducing correlation, Types of analysis, Understanding, Correlation does not imply causation.<br><br><b>Types of analysis:</b> Univariate analysis - bivariate analysis - multivariate analysis. Time Series Analysis (TSA): Fundamentals of TSA - characteristics of TSA – Time based indexing - visualizing time series – grouping time series data - resampling time series data. | <b>6</b>     |
| <b>4</b>        | <b>Visualizing Data:</b> Mapping Data onto Aesthetics Data, Scales, Coordinate Systems and Axes, Directory of Visualizations, Visualizing Amounts, Visualizing Distributions: Histograms and Density Plots, Visualizing Multiple Distributions at the Same Time.<br><br><b>Visualizing Distributions:</b> Empirical Cumulative Distribution Functions and Q-Q Plots, Visualizing Many Distributions at Once, Visualizing Associations Among Two or More Quantitative Variables, Visualizing Uncertainty, Visualizing proportions.                                                                                                       | <b>6</b>     |
| <b>5</b>        | <b>Getting Started with Pandas:</b> Arrays and vectorised computation, Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics. Data Loading, Storage and File Formats. Reading and Writing Data in Text Format, Web Scraping, Binary Data Formats, Interacting with Web APIs, Interacting with Databases, Data Cleaning and Preparation. Handling Missing Data, Data Transformation, String Manipulation. Data Wrangling: Hierarchical Indexing, Combining and Merging Data Sets Reshaping and Pivoting.                                                                     | <b>6</b>     |



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**Prescribed Text Books:**

| Sl. No. | Book Title                                                               | Authors                           | Edition         | Publisher       | Year |
|---------|--------------------------------------------------------------------------|-----------------------------------|-----------------|-----------------|------|
| 1       | Hands-On Exploratory Data Analysis with Python                           | Suresh Kumar Mukhiya, Usman Ahmed | 1 <sup>st</sup> | Packt           | 2020 |
| 2       | Fundamental of Data Visualization                                        | Claus O. Wilke                    | 1 <sup>st</sup> | O'Reilly        | 2019 |
| 3       | Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. | McKinney. W                       | 2 <sup>nd</sup> | O'Reilly Media. | 2017 |

**Reference Text Books:**

| Sl. No. | Book Title                            | Authors                     | Edition         | Publisher              | Year |
|---------|---------------------------------------|-----------------------------|-----------------|------------------------|------|
| 1       | Data Exploration and Visualization    | Anamitra Dehmukh, Nimbalkar | 1 <sup>st</sup> | Technical Publications | 2022 |
| 2       | Exploratory Data Analysis with Python | Ayodele Oluleye             | 1 <sup>st</sup> | Packt                  | 2023 |

**E-Book:**

| Sl. No. | Book Title                                            | Authors                                        | Edition         | Publisher | Year | URL                                                                                                                                                                                                         |
|---------|-------------------------------------------------------|------------------------------------------------|-----------------|-----------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Data Visualization Exploring and Explaining with Data | Jeffery D Comm, James J Cochran, Michael J Fry | 1 <sup>st</sup> | Cengage   | 2022 | <a href="https://www.perlego.com/book/3815910/data-visualization-exploring-and-explaining-with-data-pdf">https://www.perlego.com/book/3815910/data-visualization-exploring-and-explaining-with-data-pdf</a> |

**MOOC Courses:**

| Sl. No. | Course name        | Course offered by | Year | URL                                                                                                                     |
|---------|--------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------------|
| 1       | Data Visualization | Coursera          | 2023 | <a href="https://www.coursera.org/articles/data-visualization">https://www.coursera.org/articles/data-visualization</a> |
| 2       | Data Visualization | Edx               | 2023 | <a href="http://edx.org/course/data-science-visualization">http://edx.org/course/data-science-visualization</a>         |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Course Outcomes (COs):**

|            |                                                                                                                          |
|------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the computational approaches to perform Data Exploration and Visualization                                         |
| <b>CO2</b> | Analyse the different techniques to perform Data Exploration and Visualization for a given application                   |
| <b>CO3</b> | Demonstrate exploratory data analysis to real data sets and provide interpretations through relevant visualization tools |

**C-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3 | PO4 | PO5      | PO6      | PO7 | PO8 | PO9      | PO10     | PO11 | PSO1 | PSO2 | PSO3 |
|------------|----------|----------|-----|-----|----------|----------|-----|-----|----------|----------|------|------|------|------|
| <b>CO1</b> | <b>3</b> |          |     |     |          |          |     |     |          |          |      |      |      |      |
| <b>CO2</b> |          | <b>3</b> |     |     |          |          |     |     |          |          |      |      |      |      |
| <b>CO3</b> |          |          |     |     | <b>3</b> | <b>2</b> |     |     | <b>3</b> | <b>3</b> |      |      |      |      |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>     | <b>Marks</b> |
|----------------------------------------|--------------------|--------------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b>    |
| <b>Quiz</b>                            | ---                | ---          |
| <b>Lab Component</b>                   | ---                | ---          |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>         | <b>10</b>    |
| <b>Total</b>                           |                    | <b>50</b>    |

**Tutorial Plan:**

Use data set of your choice from Open Data Portal for the following hands-on exercises.

| <b>Tutorial #</b> | <b>Topic</b>                                                                         |
|-------------------|--------------------------------------------------------------------------------------|
| 1                 | NumPy ndarray                                                                        |
| 2                 | Pandas Data Structures                                                               |
| 3                 | Data Loading, Storage and File Formats                                               |
| 4                 | Interacting with Web APIs                                                            |
| 5                 | Data Cleaning and Preparation                                                        |
| 6                 | Data Wrangling                                                                       |
| 7                 | Data Visualization using matplotlib                                                  |
| 8                 | Data Aggregation                                                                     |
| 9                 | Time Series Data Analysis                                                            |
| 10-12             | Analysing a real time dataset and draw meaningful insights using visualization tools |



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**AAT Plan:**

**Plan of Activities:** Following are the activities to be carried out by students during project work.

| Sl. No | Week                                | Activity                                                             |
|--------|-------------------------------------|----------------------------------------------------------------------|
| 1      | 1 <sup>st</sup>                     | Formation of groups. Note: Student groups of size 3 to 4             |
| 2      | 2 <sup>nd</sup> and 3 <sup>rd</sup> | Project topic selection by each group                                |
| 3      | 4 <sup>th</sup>                     | Presentation-1: Student and Project topic introduction by each group |
| 4      | 5 <sup>th</sup>                     | Data Acquisition and Data Preparation                                |
| 5      | 6 <sup>th</sup> and 7 <sup>th</sup> | Presentation-2: Exploratory tools demonstration                      |
| 6      | 8 <sup>th</sup> and 9 <sup>th</sup> | Presentation-3: Techniques applied on EDA                            |
| 7      | 10 <sup>th</sup>                    | Presentation-4: Visualization tools demonstration                    |
| 8      | 11 <sup>th</sup>                    | Complete Project Work Demonstration by each group                    |
| 9      | 12 <sup>th</sup>                    | Project Report Submission                                            |

**Rubrics for Project Evaluation:**

| Criteria                                 | Exemplary                                                                                                       | Proficient                                                                                                 | Partially Proficient                                                                            | Points |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------|
| Selection of the topic                   | (5-4)<br>The topic chosen is relevant to the present scenario and is the emerging aspect pertaining to society. | (3-2)<br>The topic chosen is relevant to the present scenario and is suitable to already prevalent events. | (1)<br>The topic chosen is relevant to the present scenario and it has already been dealt with. | ___/5  |
| Data Acquisition and Data Preparation    | (10-6)<br>Students has acquired enough data with accurate data cleaning.                                        | (5-3)<br>Students has acquired enough data with little accurate data cleaning.                             | (2-1)<br>Students has acquired enough data with least accurate data cleaning.                   | ___/10 |
| Presentation on tools used by each group | (5-4)<br>Appropriate tools have been chosen to match the identified problem.                                    | (3-2)<br>Partially suitable tools have been chosen to match the identified problem.                        | (1)<br>Unrelated tools have been chosen to match the identified problem.                        | ___/5  |
| Presentation on Reporting the findings   | (10-6)<br>Excellent result has been derived from the analysis with proper visualization.                        | (5-3)<br>Good result has been derived from the analysis with proper visualization.                         | (2-1)<br>Satisfactory result has been derived from the analysis with proper visualization.      | ___/10 |



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|                                   |                                                                                    |                                                                                          |                                                                                                       |               |
|-----------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------|
| Report                            | (5-4)<br>Clear and Effective writing and adherence to appropriate style guidelines | (3-2)<br>Clear and minor errors in writing and adherence to appropriate style guidelines | (1)<br>Clear and ineffective writing and multiple errors in adherence to appropriate style guidelines | ___/5         |
| Oral communication (presentation) | (5-4)<br>Clear and effective communication                                         | (3-2)<br>Communication is clear                                                          | (1)<br>Unclear Communication                                                                          | ___/5         |
| <b>Total</b>                      |                                                                                    |                                                                                          |                                                                                                       | <b>___/40</b> |

Note: AAT will be evaluated for 40 marks and reduced to 10 marks.



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|                      |                         |                             |    |
|----------------------|-------------------------|-----------------------------|----|
| <b>Semester:</b>     | 5                       |                             |    |
| <b>Course Title:</b> | Artificial Intelligence |                             |    |
| <b>Course Code:</b>  | 23CS5PCAIN              | <b>Total Contact Hours:</b> | 42 |
| <b>L-T-P:</b>        | 3-0-1                   | <b>Total Credits:</b>       | 4  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Hours |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction:</b> Definition, Agents: Agents and environment, Concept of Rationality, The nature of environment, The structure of agents. Problem-solving: Problem-solving agents, Example problems, Searching for Solutions.                                                                                                                                                                                                                                                                         | 8     |
| 2        | <b>Uninformed Search Strategies:</b> Breadth First search, Depth First Search, Iterative deepening depth first search, Hill Climbing, Simulated annealing and Monotonicity; <b>Informed Search Strategies:</b> Heuristic functions, Greedy best first search, A*search. Heuristic Functions.                                                                                                                                                                                                             | 8     |
| 3        | <b>Logical Agents:</b> Knowledge-based agents, The Wumpus world, Logic, Propositional logic, First Order Logic: Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic.                                                                                                                                                                                                                                                                                            | 9     |
| 4        | <b>Inference in First Order Logic:</b> Propositional Versus First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.<br><br><b>Adversarial Search and Games:</b> Game playing - Classification of games - Optimal Decisions in Games - Prisoner's Dilemma – Game playing techniques - minimax search - Alpha-beta Tree search- Complexity of alpha-beta search-Monte carlo Tree Search-Stochastic Games - Partially Observable Games - Limitations of Game Search Algorithm. | 9     |
| 5        | <b>Uncertain Knowledge and Reasoning:</b> Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Independence, Baye's Rule and its use. Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, Semantics of Bayesian Networks.                                                                                                                                                                                        | 8     |

**Prescribed Text Book:**

| Sl. No. | Book Title              | Authors                           | Edition         | Publisher | Year |
|---------|-------------------------|-----------------------------------|-----------------|-----------|------|
| 1       | Artificial Intelligence | Stuart J.Russell,<br>Peter Norvig | 3 <sup>rd</sup> | Pearson   | 2015 |



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**Reference Text Books:**

| Sl. No. | Book Title                                                                     | Authors                                              | Edition         | Publisher         | Year |
|---------|--------------------------------------------------------------------------------|------------------------------------------------------|-----------------|-------------------|------|
| 1       | Artificial Intelligence                                                        | Elaine Rich,<br>Kevin Knight,<br>Shivashankar B Nair | 3 <sup>rd</sup> | Tata McGraw Hill  | 2013 |
| 2       | Artificial Intelligence: Structures and Strategies for Complex Problem Solving | George F Luger                                       | 5 <sup>th</sup> | Pearson Education | 2009 |

**E-Book:**

| Sl. No. | Book Title                                                   | Authors                           | Edition         | Publisher                  | Year | URL                                                                                                                                             |
|---------|--------------------------------------------------------------|-----------------------------------|-----------------|----------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Artificial Intelligence: Foundations of Computational Agents | David L. Poole, Alan K. Mackworth | 2 <sup>nd</sup> | Cambridge University Press | 2017 | <a href="https://www.kdnuggets.com/2019/11/10-free-must-read-books-i.html">https://www.kdnuggets.com/2019/11/10-free-must-read-books-i.html</a> |

**MOOC Courses:**

| Sl. No. | Course name                           | Course Offered By | Year | URL                                                                                                                                                                 |
|---------|---------------------------------------|-------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Knowledge-Based AI: Cognitive Systems | Udacity           | 2022 | <a href="https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409">https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409</a> |
| 2       | Artificial Intelligence               | NPTEL             | 2009 | <a href="https://nptel.ac.in/courses/106/105/106105077/">https://nptel.ac.in/courses/106/105/106105077/</a>                                                         |

**Course Outcomes (COs):**

|            |                                                                                                      |
|------------|------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply knowledge of agent architecture, searching and reasoning techniques for different applications |
| <b>CO2</b> | Analyse Searching and Inferencing Techniques                                                         |
| <b>CO3</b> | Design a reasoning and gaming system for a given requirement                                         |
| <b>CO4</b> | Conduct practical experiments for demonstrating agents, searching and inferencing                    |



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**CO-PO-PSO Mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 2   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     |     | 3   |     |     |     |     |     |     |      |      |      |      | 3    |
| CO4 |     |     |     | 3   |     |     |     |     |     |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                            | Remarks                        | Marks     |
|---------------------------------|--------------------------------|-----------|
| Internals                       | Best 2 of 3                    | 20        |
| Quiz                            | One                            | 5         |
| Lab Component                   | CIE + Lab Test + Certification | 25        |
| Alternate Assessment Tool (AAT) | ---                            | ---       |
| <b>Total</b>                    |                                | <b>50</b> |

**Laboratory Plan:**

**Instructions to Students:**

- Design, develop and implement the specified algorithms for the following problems using Python Language in LINUX / Windows environment.
- Lab Observation - Handwrite the algorithm and output of program.

**Note:** The faculty in charge of Artificial Intelligence course of all the sections must come up with two to three test cases for the programs in the laboratory set at the beginning of the semester. The students are expected to write the algorithm /program to solve these test cases. Depending on the number of test cases executed by the student the evaluation for the week must be done.

- Soft copy (PDF file) of all the programs along with the output needs to be submitted before the lab test.

| Lab Program | Unit # | Marks for Continuous Evaluation | Program Details                                 |
|-------------|--------|---------------------------------|-------------------------------------------------|
| 1           | 1      | 10                              | Implement Tic –Tac –Toe Game.                   |
| 2           | 1      | 10                              | Solve 8 puzzle problems.                        |
| 3           | 1      | 10                              | Implement Iterative deepening search algorithm. |



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|    |   |    |                                                                                                                       |
|----|---|----|-----------------------------------------------------------------------------------------------------------------------|
| 4  | 1 | 10 | Implement vacuum cleaner agent.                                                                                       |
| 5  | 2 | 10 | Implement A* search algorithm.<br>Implement Hill Climbing Algorithm.                                                  |
| 6  | 2 | 10 | Write a program to implement Simulated Annealing Algorithm                                                            |
| 7  | 3 | 10 | Create a knowledge base using propositional logic and show that the given query entails the knowledge base or not.    |
| 8  | 3 | 10 | Create a knowledge base using propositional logic and prove the given query using resolution.                         |
| 9  | 4 | 10 | Implement unification in first order logic.                                                                           |
| 10 | 4 | 10 | Convert a given first order logic statement into Conjunctive Normal Form (CNF).                                       |
| 11 | 4 | 10 | Create a knowledge base consisting of first order logic statements and prove the given query using forward reasoning. |
| 12 | 4 | 10 | Implement Alpha-Beta Pruning.                                                                                         |

Note: During the lab test evaluation, students were presented with open-ended problem statements. They were required to independently research and analyze the given problem, identify an appropriate algorithm or strategy, and implement a suitable solution.



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|                      |                   |                             |    |
|----------------------|-------------------|-----------------------------|----|
| <b>Semester:</b>     | 5                 |                             |    |
| <b>Course Title:</b> | Computer Networks |                             |    |
| <b>Course Code:</b>  | 25CS5PCCON        | <b>Total Contact Hours:</b> | 42 |
| <b>L-T-P:</b>        | 3-0-1             | <b>Total Credits:</b>       | 4  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                                                                                                                     | Hours |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction:</b> Data Communications, Networks, Network Types, Network Models, Protocol Layering, TCP/IP Protocol Suite, OSI Model.<br><b>Application Layer:</b> Introduction, Standard Client Server Protocols - World Wide Web and HTTP, Domain Name System (DNS), Network Management: Introduction, SNMP                                                                                            | 8     |
| 2        | <b>Transport Layer:</b> Transport Layer Protocols, User Datagram Protocol, Transmission Control Protocol.                                                                                                                                                                                                                                                                                                  | 8     |
| 3        | <b>Network Layer:</b> Network Layer Services, Packet Switching, Network Layer Performance, IPV4 Addresses (Address Space, Classful Addressing, Classless Addressing).<br><b>Network Layer Protocols:</b> Internet Protocol, Unicast Routing, Routing algorithms, Internet Structure, Routing Information Protocol (RIP), Next Generation IP: IPV6 Addressing, IPV6 Protocol, Transition from IPV4 to IPV6. | 9     |
| 4        | <b>Data Link Layer:</b> Link Layer Addressing, Error Detection and Correction, Block Coding, Cyclic Codes (Cyclic Redundancy Check, Polynomials, Cyclic Code Encoder Using Polynomials), Checksum.<br><b>Data Link Control:</b> DLC Services, Data-Link Layer Protocols, Media Access Control (Random access, controlled access).                                                                          | 9     |
| 5        | <b>Physical Layer:</b> Data and signals Digital Transmission, D-2-D-Line coding (Unipolar, polar, bipolar), Switching, Circuit Switched Networks, Packet Switching.                                                                                                                                                                                                                                        | 8     |

**Prescribed Text Book:**

| Sl. No. | Book Title                         | Authors            | Edition         | Publisher   | Year |
|---------|------------------------------------|--------------------|-----------------|-------------|------|
| 1       | Data Communications and Networking | Behrouz A Forouzan | 5 <sup>th</sup> | McGraw Hill | 2013 |



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**Reference Text Books:**

| Sl. No. | Book Title                             | Authors                           | Edition         | Publisher         | Year |
|---------|----------------------------------------|-----------------------------------|-----------------|-------------------|------|
| 1       | Data and Computer Communication        | William Stallings                 | 8 <sup>th</sup> | Pearson Education | 2008 |
| 2       | Computer Networks – A Systems Approach | Larry L. Peterson, Bruce S. Davie | 4 <sup>th</sup> | Elsevier          | 2007 |

**E-Book:**

| Sl. No. | Book Title        | Authors                                 | Edition         | Publisher | Year | URL                                                                                                                                                                                                         |
|---------|-------------------|-----------------------------------------|-----------------|-----------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Computer Networks | Andrew S. Tanenbaum, David J. Wetherall | 5 <sup>th</sup> | Pearson   | 2011 | <a href="https://csc-knu.github.io/sys-prog/books/Andrew%20S.%20Tanenbaum%20-%20Computer%20Networks.pdf">https://csc-knu.github.io/sys-prog/books/Andrew%20S.%20Tanenbaum%20-%20Computer%20Networks.pdf</a> |

**MOOC Courses:**

| Sl. No. | Course name                              | Course Offered by | Year | URL                                                                                                                                             |
|---------|------------------------------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Computer Networks and Internet Protocols | NPTEL             | 2022 | <a href="https://onlinecourses.nptel.ac.in/noc22_cs19/preview">https://onlinecourses.nptel.ac.in/noc22_cs19/preview</a>                         |
| 2       | Computer Networking                      | Coursera          | 2024 | <a href="https://www.coursera.org/learn/illinois-tech-computer-networking">https://www.coursera.org/learn/illinois-tech-computer-networking</a> |

**Course Outcomes (COs):**

|            |                                                                          |
|------------|--------------------------------------------------------------------------|
| <b>CO1</b> | Apply the fundamental concepts of communication in networking            |
| <b>CO2</b> | Analyse the various protocols, techniques in TCP/IP network architecture |
| <b>CO3</b> | Demonstrate the functionalities of TCP/IP layers                         |



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**CO-PO-PSO mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     |     |     |     | 3   |     |     |     |     |      |      |      | 2    |      |

**Assessment Plan for CIE:**

| Tool                            | Remarks        | Marks     |
|---------------------------------|----------------|-----------|
| Internals                       | Best 2 of 3    | 20        |
| Quiz                            | One            | 5         |
| Lab Component                   | CIE + Lab test | 25        |
| Alternate Assessment Tool (AAT) | ---            | ---       |
| <b>Total</b>                    |                | <b>50</b> |

**Laboratory Plan:**

**Instructions to be followed by Students in each lab:**

- Each student should bring the observation book for each lab and write the programs and output completed in the previous week and gets it evaluated by the faculty in charge. In the observation book, students should
  - Handwrite the Program/scenarios with topology and procedure
  - Paste the printout of the Output or Handwrite the Output (Output should be written for all the cases).
- Soft copy (PDF file) of all the experiments and programs along with the output needs to be submitted before the lab test.
- Each Student should practice the extra exercise given in each lab.

**NOTE:**

**CYCLE 1:** Exercises done using CISCO Packet Tracer

**CYCLE 2:** Execution of Lab Programs using C/C++/Python

| <b>CYCLE-1</b> |        |                                              |
|----------------|--------|----------------------------------------------|
| Experiment #   | Unit # | Name of Experiment                           |
| 1              | 1      | Configure DHCP within a LAN and outside LAN. |

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|    |   |                                                                                                                                                         |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2  | 1 | Configure Web Server, DNS within a LAN.                                                                                                                 |
| 3  | 1 | To understand the operation of TELNET by accessing the router in server room from a PC in IT office.                                                    |
| 4  | 3 | Configure IP address to routers in packet tracer. Explore the following messages: ping responses, destination unreachable, request timed out, reply     |
| 5  | 3 | Configure default route, static route to the Router                                                                                                     |
| 6  | 3 | Configure RIP routing Protocol in Routers                                                                                                               |
| 7  | 3 | Configure OSPF routing protocol                                                                                                                         |
| 8  | 3 | Demonstrate the TTL/ Life of a Packet                                                                                                                   |
| 9  | 3 | To construct a VLAN and make the PC's communicate among a VLAN                                                                                          |
| 10 | 3 | To construct a WLAN and make the nodes communicate wirelessly                                                                                           |
| 11 | 4 | To construct simple LAN and understand the concept and operation of Address Resolution Protocol (ARP)                                                   |
| 12 | 4 | Create a topology and simulate sending a simple PDU from source to destination using hub and switch as connecting devices and demonstrate ping message. |

**CYCLE-2**

| Experiment # | Unit # | Name of the Experiment                                                                                                                                              |
|--------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13           | 1,2,3  | Tool Exploration –Wireshark                                                                                                                                         |
| 14           | 2      | Write a program for congestion control using Leaky bucket algorithm.                                                                                                |
| 15           | 2      | Using TCP/IP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present. |
| 16           | 2      | Using UDP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.    |
| 17           | 4      | Write a program for error detecting code using CRC-CCITT (16-bits).                                                                                                 |



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|                      |                             |                             |           |
|----------------------|-----------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>                    |                             |           |
| <b>Course Title:</b> | <b>Bio Inspired Systems</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS5BSBIS</b>           | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-0-1</b>                | <b>Total Credits:</b>       | <b>1</b>  |

**Introduction:**

The course will expose students to the current research in several disciplines that relate to computer science, including computational neuroscience, cognitive science, biology, and evolutionary-inspired computational methods. These models have become important in several areas of computer science and the students will learn to develop models and algorithms to solve complex problems.

**Prescribed Text Books:**

| Sl. No. | Book Title                                             | Authors                                          | Edition         | Publisher            | Year |
|---------|--------------------------------------------------------|--------------------------------------------------|-----------------|----------------------|------|
| 1       | Recent Developments in Biologically Inspired Computing | Leandro Nunes De Castro, Fernando Jose Von Zuben | 2 <sup>nd</sup> | Idea Group           | 2005 |
| 2       | Handbook of bioinspired algorithms and applications    | Stephan Olariu, Albert Y. Zomaya                 | 1 <sup>st</sup> | Chapman & Hall / CRC | 2006 |

**Reference Text Books:**

| Sl. No. | Book Title                                                         | Authors      | Edition         | Publisher              | Year |
|---------|--------------------------------------------------------------------|--------------|-----------------|------------------------|------|
| 1.      | Genetic algorithms in search optimization and machine learning     | Goldberg     | 1 <sup>st</sup> | Addison Wesley         | 1999 |
| 2.      | Recent Advances in Swarm Intelligence and Evolutionary Computation | Xin-She Yang | 1 <sup>st</sup> | Springer International | 2015 |

**MOOC Courses:**

| Sl. No. | Course name                                                | Course Offered By | Year | URL                                                                                                                                                                                                                                     |
|---------|------------------------------------------------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Bio-inspired Artificial Intelligence Algorithms            | Udemy             | 2023 | <a href="https://www.udemy.com/course/bio-inspired-artificial-intelligence-algorithms-for-optimization/">https://www.udemy.com/course/bio-inspired-artificial-intelligence-algorithms-for-optimization/</a>                             |
| 2       | AI and Meta-Heuristics (Combinatorial Optimization) Python | Udemy             | 2023 | <a href="https://www.udemy.com/course/ai-and-combinatorial-optimization-with-meta-heuristics/?couponCode=SKILLS4SALEB">https://www.udemy.com/course/ai-and-combinatorial-optimization-with-meta-heuristics/?couponCode=SKILLS4SALEB</a> |



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**Course Outcomes (Cos):**

|            |                                                                                                   |
|------------|---------------------------------------------------------------------------------------------------|
| <b>CO1</b> | To apply the fundamental principles of bio-inspired systems for problem-solving and optimization. |
| <b>CO2</b> | To analyze bio-inspired approaches to implement solutions for optimization problems.              |

**CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3 | PO4      | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11     | PSO1 | PSO2     | PSO3 |
|------------|----------|----------|-----|----------|-----|-----|-----|-----|-----|------|----------|------|----------|------|
| <b>CO1</b> | <b>3</b> |          |     |          |     |     |     |     |     |      |          |      |          |      |
| <b>CO2</b> |          | <b>3</b> |     | <b>2</b> |     |     |     |     |     |      | <b>2</b> |      | <b>3</b> |      |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>        | <b>Marks</b> |
|----------------------------------------|-----------------------|--------------|
| <b>Internals</b>                       | --                    | --           |
| <b>Quiz</b>                            | --                    | --           |
| <b>Lab Component</b>                   | <b>CIE + Lab Test</b> | <b>50</b>    |
| <b>Alternate Assessment Tool (AAT)</b> | --                    | --           |
| <b>Total</b>                           |                       | <b>50</b>    |

**Laboratory Plan:**

**Instructions to be followed by Students in each lab:**

- Every lab, the student will be evaluated for 10 marks
  - If the student successfully finishes the assigned task of the lab and on spot task, in the stipulated lab hours, 10 marks will be given to the student.
  - If the student could finish only assigned task in the stipulated lab hours then the student will get 8 marks.
  - If the student could not complete the assigned task of that day lab, the student can show the completion on the same day or next day. The student will get 7 marks
  - If the student could not complete as like Case 'c', then partial marks will be given based on the completion status.
  - If the student is absent for the lab , he /she finished the assigned task and shows the execution before the next lab, the student will get 4 marks (Attendance will not be given)
  - Note: Case 'e' is allowed only twice [Only if the student is absent because of illness]
- Implement Following Algorithms using Python.

Final CIE marks (50) will be allotted as follows: Continuous Evaluation (10 marks) + Record (5 marks) + Lab Test (35 marks).



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| Sl. No. | Algorithms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <p><b>Genetic Algorithm for Optimization Problems:</b></p> <p>Genetic Algorithms (GA) are inspired by the process of natural selection and genetics, where the fittest individuals are selected for reproduction to produce the next generation. GAs are widely used for solving optimization and search problems. Implement a Genetic Algorithm using Python to solve a basic optimization problem, such as finding the maximum value of a mathematical function.</p> <p><b>Implementation Steps:</b></p> <ol style="list-style-type: none"><li>1. <b>Define the Problem:</b> Create a mathematical function to optimize.</li><li>2. <b>Initialize Parameters:</b> Set the population size, mutation rate, crossover rate, and number of generations.</li><li>3. <b>Create Initial Population:</b> Generate an initial population of potential solutions.</li><li>4. <b>Evaluate Fitness:</b> Evaluate the fitness of each individual in the population.</li><li>5. <b>Selection:</b> Select individuals based on their fitness to reproduce.</li><li>6. <b>Crossover:</b> Perform crossover between selected individuals to produce offspring.</li><li>7. <b>Mutation:</b> Apply mutation to the offspring to maintain genetic diversity.</li><li>8. <b>Iteration:</b> Repeat the evaluation, selection, crossover, and mutation processes for a fixed number of generations or until convergence criteria are met.</li><li>9. <b>Output the Best Solution:</b> Track and output the best solution found during the generations.</li></ol> |
| 2       | <p><b>Particle Swarm Optimization for Function Optimization:</b></p> <p>Particle Swarm Optimization (PSO) is inspired by the social behavior of birds flocking or fish schooling. PSO is used to find optimal solutions by iteratively improving a candidate solution with regard to a given measure of quality. Implement the PSO algorithm using Python to optimize a mathematical function.</p> <p><b>Implementation Steps:</b></p> <ol style="list-style-type: none"><li>1. <b>Define the Problem:</b> Create a mathematical function to optimize.</li><li>2. <b>Initialize Parameters:</b> Set the number of particles, inertia weight, cognitive and social coefficients.</li><li>3. <b>Initialize Particles:</b> Generate an initial population of particles with random positions and velocities.</li><li>4. <b>Evaluate Fitness:</b> Evaluate the fitness of each particle based on the optimization function.</li><li>5. <b>Update Velocities and Positions:</b> Update the velocity and position of each particle based on its own best position and the global best position.</li><li>6. <b>Iterate:</b> Repeat the evaluation, updating, and position adjustment for a fixed number of iterations or until convergence criteria are met.</li><li>7. <b>Output the Best Solution:</b> Track and output the best solution found during the iterations.</li></ol>                                                                                                                                                                  |



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|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3</b> | <p><b>Ant Colony Optimization for the Traveling Salesman Problem:</b></p> <p>The foraging behavior of ants has inspired the development of optimization algorithms that can solve complex problems such as the Traveling Salesman Problem (TSP). Ant Colony Optimization (ACO) simulates the way ants find the shortest path between food sources and their nest. Implement the ACO algorithm using Python to solve the TSP, where the objective is to find the shortest possible route that visits a list of cities and returns to the origin city.</p> <p><b>Implementation Steps:</b></p> <ol style="list-style-type: none"><li>1. <b>Define the Problem:</b> Create a set of cities with their coordinates.</li><li>2. <b>Initialize Parameters:</b> Set the number of ants, the importance of pheromone (alpha), the importance of heuristic information (beta), the evaporation rate (rho), and the initial pheromone value.</li><li>3. <b>Construct Solutions:</b> Each ant constructs a solution by probabilistically choosing the next city based on pheromone trails and heuristic information.</li><li>4. <b>Update Pheromones:</b> After all ants have constructed their solutions, update the pheromone trails based on the quality of the solutions found.</li><li>5. <b>Iterate:</b> Repeat the construction and updating process for a fixed number of iterations or until convergence criteria are met.</li><li>6. <b>Output the Best Solution:</b> Keep track of and output the best solution found during the iterations.</li></ol>                                |
| <b>4</b> | <p><b>Cuckoo Search (CS):</b></p> <p>Cuckoo Search (CS) is a nature-inspired optimization algorithm based on the brood parasitism of some cuckoo species. This behavior involves laying eggs in the nests of other birds, leading to the optimization of survival strategies. CS uses Lévy flights to generate new solutions, promoting global search capabilities and avoiding local minima. The algorithm is widely used for solving continuous optimization problems and has applications in various domains, including engineering design, machine learning, and data mining.</p> <p><b>Implementation Steps:</b></p> <ol style="list-style-type: none"><li>1. <b>Define the Problem:</b> Create a mathematical function to optimize.</li><li>2. <b>Initialize Parameters:</b> Set the number of nests, the probability of discovery, and the number of iterations.</li><li>3. <b>Initialize Population:</b> Generate an initial population of nests with random positions.</li><li>4. <b>Evaluate Fitness:</b> Evaluate the fitness of each nest based on the optimization function.</li><li>5. <b>Generate New Solutions:</b> Create new solutions via Lévy flights.</li><li>6. <b>Abandon Worst Nests:</b> Abandon a fraction of the worst nests and replace them with new random positions.</li><li>7. <b>Iterate:</b> Repeat the evaluation, updating, and replacement process for a fixed number of iterations or until convergence criteria are met.</li><li>8. <b>Output the Best Solution:</b> Track and output the best solution found during the iterations.</li></ol> |



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|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | <p><b>Grey Wolf Optimizer (GWO):</b></p> <p>The Grey Wolf Optimizer (GWO) algorithm is a swarm intelligence algorithm inspired by the social hierarchy and hunting behavior of grey wolves. It mimics the leadership structure of alpha, beta, delta, and omega wolves and their collaborative hunting strategies. The GWO algorithm uses these social hierarchies to model the optimization process, where the alpha wolves guide the search process while beta and delta wolves assist in refining the search direction. This algorithm is effective for continuous optimization problems and has applications in engineering, data analysis, and machine learning.</p> <p><b>Implementation Steps:</b></p> <ol style="list-style-type: none"><li>1. <b>Define the Problem:</b> Create a mathematical function to optimize.</li><li>2. <b>Initialize Parameters:</b> Set the number of wolves and the number of iterations.</li><li>3. <b>Initialize Population:</b> Generate an initial population of wolves with random positions.</li><li>4. <b>Evaluate Fitness:</b> Evaluate the fitness of each wolf based on the optimization function.</li><li>5. <b>Update Positions:</b> Update the positions of the wolves based on the positions of alpha, beta, and delta wolves.</li><li>6. <b>Iterate:</b> Repeat the evaluation and position updating process for a fixed number of iterations or until convergence criteria are met.</li><li>7. <b>Output the Best Solution:</b> Track and output the best solution found during the iterations</li></ol>                                                                                                                                                                                                 |
| 6 | <p><b>Parallel Cellular Algorithms and Programs:</b></p> <p>Parallel Cellular Algorithms are inspired by the functioning of biological cells that operate in a highly parallel and distributed manner. These algorithms leverage the principles of cellular automata and parallel computing to solve complex optimization problems efficiently. Each cell represents a potential solution and interacts with its neighbors to update its state based on predefined rules. This interaction models the diffusion of information across the cellular grid, enabling the algorithm to explore the search space effectively. Parallel Cellular Algorithms are particularly suitable for large-scale optimization problems and can be implemented on parallel computing architectures for enhanced performance.</p> <p><b>Implementation Steps:</b></p> <ol style="list-style-type: none"><li>1. <b>Define the Problem:</b> Create a mathematical function to optimize.</li><li>2. <b>Initialize Parameters:</b> Set the number of cells, grid size, neighborhood structure, and number of iterations.</li><li>3. <b>Initialize Population:</b> Generate an initial population of cells with random positions in the solution space.</li><li>4. <b>Evaluate Fitness:</b> Evaluate the fitness of each cell based on the optimization function.</li><li>5. <b>Update States:</b> Update the state of each cell based on the states of its neighboring cells and predefined update rules.</li><li>6. <b>Iterate:</b> Repeat the evaluation and state updating process for a fixed number of iterations or until convergence criteria are met.</li><li>7. <b>Output the Best Solution:</b> Track and output the best solution found during the iterations.</li></ol> |



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|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>7</b> | <p><b>Optimization via Gene Expression Algorithms:</b></p> <p>Gene Expression Algorithms (GEA) are inspired by the biological process of gene expression in living organisms. This process involves the translation of genetic information encoded in DNA into functional proteins. In GEA, solutions to optimization problems are encoded in a manner similar to genetic sequences. The algorithm evolves these solutions through selection, crossover, mutation, and gene expression to find optimal or near-optimal solutions. GEA is effective for solving complex optimization problems in various domains, including engineering, data analysis, and machine learning.</p> <p><b>Implementation Steps:</b></p> <ol style="list-style-type: none"><li>1. <b>Define the Problem:</b> Create a mathematical function to optimize.</li><li>2. <b>Initialize Parameters:</b> Set the population size, number of genes, mutation rate, crossover rate, and number of generations.</li><li>3. <b>Initialize Population:</b> Generate an initial population of random genetic sequences.</li><li>4. <b>Evaluate Fitness:</b> Evaluate the fitness of each genetic sequence based on the optimization function.</li><li>5. <b>Selection:</b> Select genetic sequences based on their fitness for reproduction.</li><li>6. <b>Crossover:</b> Perform crossover between selected sequences to produce offspring.</li><li>7. <b>Mutation:</b> Apply mutation to the offspring to introduce variability.</li><li>8. <b>Gene Expression:</b> Translate genetic sequences into functional solutions.</li><li>9. <b>Iterate:</b> Repeat the selection, crossover, mutation, and gene expression processes for a fixed number of generations or until convergence criteria are met.</li><li>10. <b>Output the Best Solution:</b> Track and output the best solution found during the iterations.</li></ol> |
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|                      |                                                 |                             |    |
|----------------------|-------------------------------------------------|-----------------------------|----|
| <b>Semester:</b>     | 5                                               |                             |    |
| <b>Course Title:</b> | Robot Process Automation Design and Development |                             |    |
| <b>Course Code:</b>  | 23CS5PERPA                                      | <b>Total Contact Hours:</b> | 42 |
| <b>L-T-P:</b>        | 3-0-0                                           | <b>Total Credits:</b>       | 3  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Hours |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Robotic Process Automation:</b><br>Scope and Techniques of automation: Techniques of automation Robotic Process Automation: Benefits of RPA Components of RPA, RPA platforms. About UiPath. The future of automation.<br><br><b>Record and Play:</b> UiPath stack, Downloading and Installing UiPath Studio, Learning UiPath Studio, Task Recorder, emptying trash in Gmail, Emptying Recycle Bin.                                                                                                                        | 8     |
| 2        | <b>Sequence, Flowchart, and Control Flow:</b> Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, to use a sequence, to use a flowchart, step by step example using sequence and control flow.<br><br><b>Data Manipulation:</b> Variables and scope, Collections, Arguments-purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example. CSV/Excel to data table and vice versa examples.                                    | 8     |
| 3        | <b>Taking control of the controls:</b> Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls-mouse and keyboard activities, working with UiExplorer, Handling events, Revisit recorder, Screen scraping, when to use OCR, Types of OCR available, to use OCR, Avoiding typical failure points.<br><br><b>Tame that Application with Plugins and Extensions Terminal plugin:</b> Mail plugin, PDF plugin, web integration, Excel and Word plugins, Credential management. | 9     |
| 4        | <b>Handling User Events and Assistant Bots:</b> Assistant bots, monitoring system event triggers, monitoring image and element triggers, Launching an assistant bot on a keyboard event.<br><br><b>Exception Handling, Debugging, and Logging Exception handling:</b> Common exceptions and ways to handle them, Logging and taking screenshots, debugging techniques, Collecting crash dumps, Error reporting.                                                                                                              | 8     |



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|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>5</b> | <p><b>Managing and Maintaining the Code:</b> Project Organization, Nesting workflows, Reusability of workflows, commenting techniques, State Machine, when to use Flowcharts, State Machines or sequences, Using config files and examples of a config file.</p> <p><b>Deploying and Maintaining the Bot:</b> Publishing using publish utility, Overview of Orchestration Server, Using Orchestration Server to control bots, Using Orchestration Server to deploy bots.</p> | <b>9</b> |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|

**Prescribed Text Book:**

| Sl. No. | Book Title                          | Authors            | Edition         | Publisher | Year |
|---------|-------------------------------------|--------------------|-----------------|-----------|------|
| 1       | Learning Robotic Process Automation | Alok Mani Tripathi | 1 <sup>st</sup> | Packt     | 2018 |

**Reference Text Book:**

| Sl. No. | Book Title                          | Authors                                | Edition         | Publisher | Year |
|---------|-------------------------------------|----------------------------------------|-----------------|-----------|------|
| 1       | Robotic Process Automation Projects | Nandan Mullakara,<br>Arun Kumar Asokan | 1 <sup>st</sup> | Packt     | 2020 |

**E-Book:**

| Sl. No. | Book Title                          | Authors            | Edition         | Publisher | Year | URL                                                                                                                                                                                                   |
|---------|-------------------------------------|--------------------|-----------------|-----------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Learning Robotic Process Automation | Alok Mani Tripathi | 1 <sup>st</sup> | Packt     | 2018 | <a href="https://book.akij.net/eBooks/2018/November/5be2a5c7bc9bd/Sanet.st_Learning_Robotic_Proc.pdf">https://book.akij.net/eBooks/2018/November/5be2a5c7bc9bd/Sanet.st_Learning_Robotic_Proc.pdf</a> |

**MOOC Courses:**

| Sl. No. | Course name                    | Course offered by | Year | URL                                                                                                               |
|---------|--------------------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------|
| 1       | RPA                            | UiPath            | 2016 | <a href="https://www.uipath.com/developers/video-tutorials">https://www.uipath.com/developers/video-tutorials</a> |
| 2.      | UiPath Tutorials for Beginners | Guru99            | 2024 | <a href="https://www.guru99.com/uipath-tutorial.html">https://www.guru99.com/uipath-tutorial.html</a>             |



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**Course Outcomes (COs):**

|     |                                                                                                |
|-----|------------------------------------------------------------------------------------------------|
| CO1 | Apply the concept of Robotic Process Automation to automate various applications.              |
| CO2 | Analyse the usage of appropriate Robotic Process Automation technique for a given application. |
| CO3 | Design and implement techniques of Robotic Process Automation.                                 |

**CO-PO-PSO Mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     |     | 3   |     | 3   |     |     |     | 2   | 2    |      |      | 2    |      |

**Assessment Plan for CIE:**

| Tool                            | Remarks     | Marks |
|---------------------------------|-------------|-------|
| Internals                       | Best 2 of 3 | 40    |
| Quiz                            | --          | --    |
| Lab Component                   | --          | --    |
| Alternate Assessment Tool (AAT) | One         | 10    |
| Total                           |             | 50    |



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|                      |                        |                             |           |
|----------------------|------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>               |                             |           |
| <b>Course Title:</b> | <b>Compiler Design</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS5PECPD</b>      | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>           | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                   | <b>Hours</b> |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Introduction, Lexical Analysis:</b> Language processors, The Structure of Compilers, Lexical analysis: The Role of Lexical Analyzer, Input Buffering, Specifications of Tokens, recognition of Tokens.                                                                       | <b>8</b>     |
| <b>2</b>        | <b>Syntax Analysis:</b> Introduction, Parsing: Top-down Parsing, Bottom-up Parsing, Introduction to LR Parsing: Simple LR parser, More Powerful LR Parsers                                                                                                                      | <b>9</b>     |
| <b>3</b>        | Syntax-Directed Definitions, Evaluation order for SDDs, Applications of Syntax-directed translation, Syntax-directed translation schemes.                                                                                                                                       | <b>8</b>     |
| <b>4</b>        | <b>Intermediate Code Generation:</b> Variants of syntax trees, Three-address code, Types and declarations, Translation of expressions, Control flow, Switch statements                                                                                                          | <b>9</b>     |
| <b>5</b>        | <b>Run-Time Environments:</b> Storage Organization, Stack Allocation of Space. Code Generation: Issues in the design of Code Generator, The Target language, Addresses in the target code, Basic blocks and Flow graphs, Optimization of basic blocks, A Simple Code Generator. | <b>8</b>     |

**Prescribed Text Book:**

| <b>Sl. No.</b> | <b>Book Title</b>                          | <b>Authors</b>                                                     | <b>Edition</b>  | <b>Publisher</b>  | <b>Year</b> |
|----------------|--------------------------------------------|--------------------------------------------------------------------|-----------------|-------------------|-------------|
| 1              | Compilers Principles, Techniques and Tools | Alfred V Aho,<br>Monica S. Lam,<br>Ravi Sethi,<br>Jeffrey D Ullman | 2 <sup>nd</sup> | Pearson Education | 2012        |

**Reference Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>      | <b>Authors</b>                 | <b>Edition</b>  | <b>Publisher</b>        | <b>Year</b> |
|----------------|------------------------|--------------------------------|-----------------|-------------------------|-------------|
| 1              | Compiler Design        | K Muneeshwaran                 | 1 <sup>st</sup> | Oxford University Press | 2012        |
| 2              | Compiler Construction  | K.V.N.Sunitha                  | 1 <sup>st</sup> | Pearson                 | 2013        |
| 3              | Engineering a Compiler | Keith Cooper,<br>Linda Torczon | 2 <sup>nd</sup> | Morgan Kaufmann         | 2011        |



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**E-Book:**

| Sl. No. | Book Title                                    | Authors             | Edition         | Publisher               | Year | URL                                                                                                                             |
|---------|-----------------------------------------------|---------------------|-----------------|-------------------------|------|---------------------------------------------------------------------------------------------------------------------------------|
| 1       | Introduction to Compilers and Language Design | Prof. Douglas Thain | 2 <sup>nd</sup> | Independently published | 2023 | <a href="https://www3.nd.edu/~dthain/compilebook/compilerbook.pdf">https://www3.nd.edu/~dthain/compilebook/compilerbook.pdf</a> |

**MOOC Course:**

| Sl. No. | Course name     | Course Offered By | Year | URL                                                                                                                     |
|---------|-----------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------------|
| 1       | Compiler Design | NPTEL             | 2021 | <a href="https://onlinecourses.nptel.ac.in/noc21_cs07/preview">https://onlinecourses.nptel.ac.in/noc21_cs07/preview</a> |

**Course Outcomes (COs):**

|            |                                                                                                                                                                                              |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply principles of lexical analysis, context-free grammars, parsing techniques, syntax-directed translation, and semantic analysis to construct different phases of a compiler.             |
| <b>CO2</b> | Analyze intermediate representations, runtime environments, target-code generation, basic blocks, flow graphs, and code optimization techniques to improve compiler design and performance.  |
| <b>CO3</b> | Design and implement a domain-specific compiler by integrating lexical analysis, syntax analysis, semantic analysis, intermediate-code generation, optimization, and target-code generation. |

**CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5      | PO6 | PO7 | PO8      | PO9      | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|----------|----------|----------|-----|----------|-----|-----|----------|----------|------|------|------|------|------|
| <b>CO1</b> | <b>3</b> |          |          |     |          |     |     |          |          |      |      |      |      |      |
| <b>CO2</b> |          | <b>2</b> |          |     |          |     |     |          |          |      |      |      |      |      |
| <b>CO3</b> |          |          | <b>2</b> |     | <b>3</b> |     |     | <b>2</b> | <b>2</b> |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                                   | Remarks    | Marks     |
|----------------------------------------|------------|-----------|
| <b>Internals</b>                       | <b>Two</b> | <b>40</b> |
| <b>Quiz</b>                            | --         | --        |
| <b>Lab Component</b>                   | --         | --        |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b> | <b>10</b> |
| <b>Total</b>                           |            | <b>50</b> |



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**AAT Plan**

Students shall design and implement a domain-specific or restricted programming language compiler for a selected application domain. The implementation shall demonstrate the major compiler phases covered in the course, including lexical analysis, syntax analysis, syntax-directed/semantic processing, symbol-table management, intermediate-code generation, basic-block/control-flow analysis, code optimization, and target-code generation. The project shall include language specification, grammar, implementation, testing, documentation, demonstration and viva voce.

| Sl. No | Week        | Activity                                                     | Expected Submission/Evidence                  | No. of hours for self-learning |
|--------|-------------|--------------------------------------------------------------|-----------------------------------------------|--------------------------------|
| 1      | 1st & 2nd   | Topic allocation, problem definition, language specification | Proposal + initial grammar                    | 6                              |
| 2      | 3rd and 4th | Lexical and syntax design                                    | Token specification + grammar + parser design | 6                              |
| 3      | 5th & 6th   | Prototype implementation                                     | Lexical analyzer + parser prototype           | 6                              |
| 4      | 7th & 8th   | Semantic analysis and TAC                                    | Symbol table + semantic checks + TAC          | 6                              |
| 5      | 9th & 10th  | Optimization, target code and testing                        | Working end-to-end prototype + test report    | 6                              |
| 6      | 11th & 12th | Final demonstration and viva                                 | Final code + report + presentation            | 6                              |

**Rubrics used for AAT evaluation:**

| Sl. No. | Criterion         | Related Weeks / Activities                    | Excellent                   | Good                 | Satisfactory              | Needs Improvement           | Marks |
|---------|-------------------|-----------------------------------------------|-----------------------------|----------------------|---------------------------|-----------------------------|-------|
| 1       | Compiler concepts | Proposal + initial grammar                    | Accurate, comprehensive (5) | Minor gaps (4)       | Basic understanding (3)   | Major gaps (2)              | 5     |
| 2       | Implementation    | Token specification + grammar + parser design | Complete and robust (20)    | Mostly complete (15) | Partially functional (10) | Non-functional/limited (05) | 20    |
| 3       | Correctness       | Lexical analyzer + parser prototype           | All major cases work (20)   | Few issues (15)      | Several issues (10)       | Frequent failures (05)      | 20    |
| 4       | Testing           | Symbol table + semantic                       | Systematic valid/invalid    | Adequate testing (8) | Limited testing (6)       | Insufficient testing (4)    | 10    |



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| Sl. No. | Criterion     | Related Weeks / Activities                 | Excellent                                     | Good                            | Satisfactory          | Needs Improvement                 | Marks |
|---------|---------------|--------------------------------------------|-----------------------------------------------|---------------------------------|-----------------------|-----------------------------------|-------|
|         |               | checks + TAC                               | testing (10)                                  |                                 |                       |                                   |       |
| 5       | Optimization  | Working end-to-end prototype + test report | 2+ correct techniques with evidence (15)      | 2 techniques, minor issues (10) | 1 technique (8)       | Not implemented (5)               | 15    |
| 6       | Documentation | Final code + report                        | Clear, complete, reproducible (15)            | Mostly complete (10)            | Basic (8)             | Incomplete (5)                    | 15    |
| 7       | Demo/Viva     | presentation                               | Explains and modifies system confidently (15) | Good explanation (10)           | Basic explanation (8) | Cannot explain implementation (5) | 15    |



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|                      |                          |                             |           |
|----------------------|--------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>                 |                             |           |
| <b>Course Title:</b> | <b>Computer Graphics</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS5PECGH</b>        | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>             | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Hours</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Computer Graphics Hardware:</b> Video Display Devices, Raster-Scan Systems, Graphics Networks, Graphics on the Internet.<br><b>Computer Graphics Software:</b> Coordinate Representations, Graphics Functions, Software Standards, Other Graphics Packages, Introduction to OpenGL.<br><b>Graphics Output Primitives:</b> Coordinate Reference Frames, Specifying a Two-Dimensional World-Coordinate Reference Frame in OpenGL, OpenGL Point Functions, OpenGL Line Functions, OpenGL Curve Functions.               | <b>8</b>     |
| <b>2</b>        | Fill-Area Primitives, Polygon Fill Areas, OpenGL Polygon Fill-Area Functions, OpenGL Vertex Arrays, Pixel-Array Primitives, OpenGL Pixel-Array Functions, Character Primitives, OpenGL Character Functions, Picture Partitioning, OpenGL Display Lists, OpenGL Display-Window Reshape Function.<br><b>Attributes of Graphics Primitives:</b> OpenGL State Variables, OpenGL Color Functions, OpenGL Point-Attribute Functions, OpenGL Line-Attribute Functions, Curve Attributes, OpenGL Fill-Area Attribute Functions. | <b>9</b>     |
| <b>3</b>        | <b>Implementation Algorithms for Graphics Primitives and Attributes:</b> Line-Drawing Algorithms, Parallel Line Algorithms, Setting Frame-Buffer Values, Circle-Generating Algorithms.<br><b>Two-Dimensional Geometric Transformations:</b> Basic Two-Dimensional Geometric Transformations, Matrix Representations and Homogeneous Coordinates, Inverse Transformations, Two-Dimensional Composite Transformations, Other Two-Dimensional Transformations, Raster Methods for Geometric Transformations.               | <b>9</b>     |
| <b>4</b>        | <b>Two-Dimensional Viewing:</b> The Two-Dimensional Viewing Pipeline, The Clipping Window, Normalization and Viewport transformations, OpenGL Two-Dimensional Viewing Functions, Clipping Algorithms, Two-Dimensional Point Clipping, Two-dimensional Line Clipping (Cohen-Sutherland Line Clipping and Liang-Barsky Line Clipping), Polygon Fill-Area Clipping (Sutherland- Hodgman Polygon Clipping.                                                                                                                  | <b>8</b>     |



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|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>5</b> | <b>Three-Dimensional Viewing:</b> Overview of Three-Dimensional Viewing Concepts, The Three-Dimensional Viewing Pipeline, Three-Dimensional Viewing-Coordinate Parameters, Transformation from World to Viewing Coordinates, Projection Transformations, Orthogonal Projections, Perspective Projections, The Viewport Transformation and Three-Dimensional Screen Coordinates, OpenGL Three-Dimensional Viewing Functions, Three-Dimensional Clipping Algorithms, OpenGL Optional Clipping Planes. | <b>8</b> |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|

**Prescribed Text Book:**

| Sl. No. | Book Title                    | Authors                       | Edition         | Publisher                 | Year |
|---------|-------------------------------|-------------------------------|-----------------|---------------------------|------|
| 1       | Computer Graphics with OpenGL | Donald Hearn, M Pauline Baker | 4 <sup>th</sup> | Pearson Education Limited | 2012 |

**Reference book:**

| Sl. No | Book Title                     | Authors                   | Edition         | Publisher                 | Year |
|--------|--------------------------------|---------------------------|-----------------|---------------------------|------|
| 1      | Computer Graphics using OpenGL | FS Hill, Stephen M Kelley | 3 <sup>rd</sup> | Pearson Education Limited | 2007 |

**E book:**

| Sl. No | Book Title                                   | Authors          | Edition         | Link                                                                                | Year |
|--------|----------------------------------------------|------------------|-----------------|-------------------------------------------------------------------------------------|------|
| 1      | Computer Vision: Algorithms and Applications | Richard Szeliski | 2 <sup>nd</sup> | <a href="https://math.hws.edu/graphicsbook/">https://math.hws.edu/graphicsbook/</a> | 2022 |

**MOOC Courses:**

| Sl. No. | Course name       | Course offered by | Year | URL                                                                                                         |
|---------|-------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------|
| 1       | Computer Graphics | Edx               | 2024 | <a href="https://www.edx.org/course/computer-graphics-2">https://www.edx.org/course/computer-graphics-2</a> |
| 2       | Computer Graphics | NPTEL             | 2024 | <a href="https://onlinecourses.nptel.ac.in/noc20_cs90">https://onlinecourses.nptel.ac.in/noc20_cs90</a>     |



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### **Course Outcomes (COs):**

|            |                                                                                    |
|------------|------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply suitable software modules for developing graphics applications using OpenGL. |
| <b>CO2</b> | Analyse various graphic transformation algorithms.                                 |
| <b>CO3</b> | Design graphics-based applications using different transformations and viewing.    |

### **CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5 | PO6 | PO7 | PO8 | PO9      | PO10     | PO11 | PSO1 | PSO2 | PSO3     |
|------------|----------|----------|----------|-----|-----|-----|-----|-----|----------|----------|------|------|------|----------|
| <b>CO1</b> | <b>3</b> |          |          |     |     |     |     |     |          |          |      |      |      |          |
| <b>CO2</b> |          | <b>3</b> |          |     |     |     |     |     |          |          |      |      |      |          |
| <b>CO3</b> |          |          | <b>3</b> |     |     |     |     |     | <b>2</b> | <b>2</b> |      |      |      | <b>2</b> |

### **Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>     | <b>Marks</b> |
|----------------------------------------|--------------------|--------------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b>    |
| <b>Quiz</b>                            | --                 | --           |
| <b>Lab Component</b>                   | --                 | --           |
| <b>Alternate Assessment tool (AAT)</b> | <b>One</b>         | <b>10</b>    |
| <b>Total</b>                           |                    | <b>50</b>    |



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|                      |                            |                             |           |
|----------------------|----------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>                   |                             |           |
| <b>Course Title:</b> | <b>Advanced Algorithms</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS5PEAAM</b>          | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>               | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                 | <b>Hours</b> |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Dynamic Programming:</b> Rod cutting, Matrix-chain multiplication, Longest common subsequence, Multistage graph, Longest increasing subsequence, Edit Distance, Egg Dropping Puzzle                                                                                                        | <b>8</b>     |
| <b>2</b>        | <b>Maximum Flow:</b> Flow networks, The Ford-Fulkerson method, Maximum bipartite matching<br><b>Multithreaded Algorithms:</b> The basics of dynamic multithreading, Multithreaded matrix multiplication, Multithreaded merge sort                                                             | <b>8</b>     |
| <b>3</b>        | <b>String matching:</b> The naive string-matching algorithm, The Rabin-Karp algorithm, String matching with finite automata. Input Enhancement in String Matching: The Knuth-Morris-Pratt algorithm                                                                                           | <b>9</b>     |
| <b>4</b>        | <b>Linear Programming:</b> Standard and slack forms, Formulating problems as linear programs, The simplex algorithm                                                                                                                                                                           | <b>8</b>     |
| <b>5</b>        | <b>Computational Geometry:</b> Line-segment properties, determining whether any pair of segments intersects, Finding the convex hull, Finding the closest pair of points<br><b>Approximation Algorithms:</b> The traveling-salesman problem, the set-covering problem, The subset-sum problem | <b>9</b>     |

**Prescribed Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                                    | <b>Authors</b>                                                        | <b>Edition</b>  | <b>Publisher</b> | <b>Year</b> |
|----------------|------------------------------------------------------|-----------------------------------------------------------------------|-----------------|------------------|-------------|
| <b>1</b>       | Introduction to Algorithms                           | Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein | 3 <sup>rd</sup> | The MIT Press    | 2009        |
| <b>2</b>       | Introduction to the Design and Analysis of Algorithm | Anany Levitin                                                         | 3 <sup>rd</sup> | Pearson          | 2011        |



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**Reference Text Book:**

| Sl. No. | Book Title                          | Authors                                          | Edition         | Publisher                 | Year |
|---------|-------------------------------------|--------------------------------------------------|-----------------|---------------------------|------|
| 1       | Fundamentals of Computer Algorithms | Ellis Horowitz,<br>Satraj Sahni,<br>Rajasekharam | 2 <sup>nd</sup> | University Press Pvt. Ltd | 2009 |

**E-Book:**

| Sl. No. | Book Title                                    | Authors          | Edition         | Publisher         | Year | URL                                                                                                                                                                                                                 |
|---------|-----------------------------------------------|------------------|-----------------|-------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Data structures and Algorithm Analysis in C++ | Mark Allen Weiss | 4 <sup>th</sup> | Pearson Education | 2014 | <a href="http://www.uoitc.edu.iq/images/documents/informatics-institute/Competitive_exam/DataStructures.pdf">http://www.uoitc.edu.iq/images/documents/informatics-institute/Competitive_exam/DataStructures.pdf</a> |

**MOOC Course:**

| Sl. No. | Course name                        | Course Offered By | Year | URL                                                                                                                                               |
|---------|------------------------------------|-------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Advanced Algorithms and Complexity | Coursera          | 2022 | <a href="https://www.coursera.org/learn/advanced-algorithms-and-complexity">https://www.coursera.org/learn/advanced-algorithms-and-complexity</a> |

**Course Outcomes (COs):**

|            |                                                                                                                  |
|------------|------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply appropriate algorithm techniques for various computing scenarios.                                          |
| <b>CO2</b> | Analyse the complexity of given algorithm                                                                        |
| <b>CO3</b> | Design efficient algorithms for a given problem by choosing appropriate design technique and implement the same. |



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**CO-PO-PSO Mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 2   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     |     | 3   |     |     |     |     |     | 2   | 2    |      |      |      | 3    |

**Assessment Plan for CIE:**

| Tool                            | Remarks     | Marks |
|---------------------------------|-------------|-------|
| Internals                       | Best 2 of 3 | 40    |
| Quiz                            | --          | --    |
| Lab Component                   | --          | --    |
| Alternate Assessment Tool (AAT) | One         | 10    |
| Total                           |             | 50    |

**AAT Plan:**

Students have to form teams of 3 to 4. Each team will select a problem. Student will have to think of an efficient design paradigm, appropriate data structure and solve the problem. They are required to present their solution and justify the technique used based on its efficiency. To conclude they will have to submit a report.

**Plan of Activities:**

Following are the activities to be carried out by students during project work:

| Sl. No | Week                                | Activity                                                                   |
|--------|-------------------------------------|----------------------------------------------------------------------------|
| 1      | 1 <sup>st</sup>                     | Formation of groups. Note: Student groups of size 3 to 4                   |
| 2      | 2 <sup>nd</sup> and 3 <sup>rd</sup> | Selection of project topic.                                                |
| 3      | 4 <sup>th</sup>                     | Time to analyse the problem and come up with appropriate design technique. |
| 4      | 5 <sup>th</sup>                     | Time to analyse the problem and come up with appropriate design technique. |
| 5      | 6 <sup>th</sup> and 7 <sup>th</sup> | Implementation                                                             |
| 6      | 8 <sup>th</sup> and 9 <sup>th</sup> | Implementation                                                             |
| 7      | 10 <sup>th</sup>                    | Implementation                                                             |
| 8      | 11 <sup>th</sup>                    | Complete Project Work Demonstration by each group                          |
| 9      | 12 <sup>th</sup>                    | Project Report Submission                                                  |



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**Rubrics used for evaluation:**

| Criteria                          | Exemplary                                                                           | Proficient                                                                                                                   | Partially Proficient                                                                                      | Points        |
|-----------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------|
| Algorithm Design                  | (10-7)<br>An efficient algorithm is designed with appropriate design technique.     | (6-4)<br>An algorithm is designed with appropriate design technique.                                                         | (3-0)<br>An algorithm is designed without concern to complexity                                           | ___/10        |
| Implementation                    | (10-7)<br>Correct implementation of the algorithm with appropriate data structures. | (6-4)<br>Correct implementation of algorithm.                                                                                | (3-0)<br>Algorithm is not implemented in accordance with the design.                                      | ___/10        |
| Oral communication (presentation) | (10-7)<br>Clear and effective communication<br>Answers all the questions            | (6-4)<br>Communication is clear<br>Answered most of the questions                                                            | (3-0)<br>Unclear communication<br>Answered only few of the questions                                      | ___/10        |
| Report                            | (10-7)<br>Clear and Effective writing and adherence to appropriate style guidelines | (6-4)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines | (3-0)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines | ___/10        |
| <b>Total</b>                      |                                                                                     |                                                                                                                              |                                                                                                           | <b>___/40</b> |

**Note:** AAT will be evaluated for 40 marks and reduced to 10 marks



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|                      |                                                    |                             |           |
|----------------------|----------------------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>                                           |                             |           |
| <b>Course Title:</b> | <b>Product, Services and IT Service Management</b> |                             |           |
| <b>Course Code:</b>  | <b>25CS5PEPSI</b>                                  | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                                       | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Hours</b> |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1               | <b>Overview of Products and IT Services:</b> Introduction to industrial revolutions from 1.0 to 5.0, overview of products, services, and their underlying components, IT Infrastructure, Data Center and Cloud computing, Application management (Development to maintenance)                                                                                                                                                                                                                                                           | 8            |
| 2               | <b>IT Service Management and delivery of IT Services:</b> Introduction to IT Service Management, the standards and frameworks in the industry and its evolution, concepts Value management, 4 Ps of IT service management, Principles and guidelines, IT Service management process and procedures overview                                                                                                                                                                                                                             | 8            |
| 3               | <b>IT Service Management best practices:</b> Application of IT service management best practices in IT Service delivery,<br><br><b>Portfolio, Program and Project Management while delivering IT Product and Services:</b> Introduction to Portfolio, Program and Project Management structure and its importance while delivering IT products and services. Methodologies and industry practices, Agile overview, Concepts of Scrum, Kanban and Lean, use of Agile mindset, principles and methods in IT products and service delivery | 9            |
| 4               | <b>Everything as a Service:</b> Different types of Cloud based computing models (IaaS, PaaS, SaaS), Role of service management in service-based cloud model, importance of service integration and management in multi supplier environment.<br><br><b>DevOps and IT Service management:</b> Introduction to DevOps, management of deployment and releases, improve resilience and reliability of products and IT services, understanding service mindset                                                                               | 9            |
| 5               | <b>Use of technology to manage services:</b> How technology enables management of services, tools for IT service management, IT operations management (event monitoring and integration), Toil reduction using automation, Artificial Intelligence infused IT service operations                                                                                                                                                                                                                                                        | 8            |



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**Prescribed textbook:**

| Sl. No. | Book Title                                                                     | Authors          | Edition | Publisher                           | Year |
|---------|--------------------------------------------------------------------------------|------------------|---------|-------------------------------------|------|
| 1       | ITIL Foundation: ITIL 4 Edition (ITIL 4 Foundation)                            | Axelos           | 2nd     | Axelos UK                           | 2024 |
| 2       | Mastering IT Infrastructure Management: Concepts, Techniques, and Applications | Nikhilesh Mishra | NA      | Independently Published (by Amazon) | 2023 |
| 3       | Agile Essentials: From Concepts to Customer Delight                            | Rahul Shah       | NA      | Notion Press Media Pvt Ltd          | 2025 |

**Course Outcomes (COs):**

**Students will be able to**

|            |                                                                                              |
|------------|----------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concepts of IT Service management in product and service lifecycle                 |
| <b>CO2</b> | Analyse the underlying components (Infrastructure and Applications) of products and services |
| <b>CO3</b> | Design the value co-creation process to improve the overall customer and user experience     |

**CO-PO-PSO mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      | 3    |      |      |
| CO2 |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     |     | 3   |     |     | 2   |     | 2   | 2   |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                 | Remarks    | Marks     |
|----------------------|------------|-----------|
| <b>Internals</b>     | <b>Two</b> | <b>40</b> |
| <b>Quiz</b>          | -          | -         |
| <b>Lab Component</b> | -          | -         |
| <b>AAT</b>           | <b>One</b> | <b>10</b> |
| <b>Total</b>         |            | <b>50</b> |



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**AAT Plan**

| Sl. No | Week | Activity                                                                           |
|--------|------|------------------------------------------------------------------------------------|
| 1      | 3rd  | Formation of groups.<br>Note: Groups size - min 4 and max 6 students               |
| 2      | 5th  | AAT (case study) topic selection by each group                                     |
| 3      | 6th  | Presentation: Team and topic introduction by each group                            |
| 4      | 8th  | Presentation: Share the understanding of problem                                   |
| 7      | 10th | Presentation: Present the analysis of the problem and possible causes              |
| 8      | 12th | Presentation: Present the solution steps and possible outcome that can be achieved |
| 9      | 15th | Final AAT presentation submission                                                  |

| Criteria                                 | Exemplary                                                                                                       | Proficient                                                                                                 | Partially Proficient                                                                            | Points   |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------|
| Selection of the topic                   | (5-4)<br>The topic chosen is relevant to the present scenario and is the emerging aspect pertaining to society. | (3-2)<br>The topic chosen is relevant to the present scenario and is suitable to already prevalent events. | (1)<br>The topic chosen is relevant to the present scenario and it has already been dealt with. | ___ / 5  |
| Data Acquisition and Data Preparation    | (10-6)<br>Students has acquired enough data with accurate data cleaning.                                        | (5-3)<br>Students has acquired enough data with little accurate data cleaning.                             | (2-1)<br>Students has acquired enough data with least accurate data cleaning.                   | ___ / 10 |
| Presentation on tools used by each group | (5-4)<br>Appropriate tools have been chosen to match the identified problem.                                    | (3-2)<br>Partially suitable tools have been chosen to match the identified problem.                        | (1)<br>Unrelated tools have been chosen to match the identified problem.                        | ___ / 5  |
| Presentation on Reporting the findings   | (10-6)<br>Excellent result has been derived from the analysis with proper visualization.                        | (5-3)<br>Good result has been derived from the analysis with proper visualization.                         | (2-1)<br>Satisfactory result has been derived from the analysis with proper visualization.      | ___ / 10 |



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|                                   |                                                       |                                                          |                                                                          |            |
|-----------------------------------|-------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------|------------|
| Report                            | (5-4)<br>Clear and Effective                          | (3-2)<br>Clear and minor errors                          | (1)<br>Clear and ineffective                                             | ___/5      |
|                                   | writing and adherence to appropriate style guidelines | in writing and adherence to appropriate style guidelines | writing and multiple errors in adherence to appropriate style guidelines |            |
| Oral communication (presentation) | (5-4)<br>Clear and effective communication            | (3-2)<br>Communication is clear                          | (1)<br>Unclear Communication                                             | ___/5      |
| Total                             |                                                       |                                                          |                                                                          | ___/<br>40 |



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|                      |                                   |                             |           |
|----------------------|-----------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>                          |                             |           |
| <b>Course Title:</b> | <b>Automated Software Testing</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS5AEAST</b>                 | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-0-1</b>                      | <b>Total Credits:</b>       | <b>1</b>  |

**Guidelines:**

- This course enables students to identify the requirements and develop the appropriate functional testing strategies for a given problem.
- The student will be able to select appropriate tools that could be used to generate test cases.
- Students will also gain hands-on experience in generating test-cases, and verify the test cases as per the specification.

**Reference Text Books:**

| Sl. No | Book Title                                                                                           | Authors                           | Edition         | Publisher         | Year |
|--------|------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------|-------------------|------|
| 1      | Software Testing: A Craftsman's Approach                                                             | Paul C. Jorgensen, Byron De Vries | 5 <sup>th</sup> | Auerbach          | 2022 |
| 2      | Foundations of Software Testing                                                                      | Aditya P Mathur                   | 2 <sup>nd</sup> | Pearson Education | 2013 |
| 3      | The Craft of Software Testing: Subsystems Testing Including Object-Based and Object-Oriented Testing | Brian Marrick                     | 2 <sup>nd</sup> | Pearson Education | 2007 |

**Tutorial Links:**

1. <https://nptel.ac.in/courses/106/105/106105150>
2. [https://onlinecourses.nptel.ac.in/noc19\\_cs71/preview](https://onlinecourses.nptel.ac.in/noc19_cs71/preview)
3. <https://www.javatpoint.com/selenium-tutorial>
4. Introduction to Selenium - <https://www.youtube.com/watch?v=FRn5J31eAMw>

**Course Outcomes (COs):**

|            |                                                                                        |
|------------|----------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concepts of software testing to assess the most appropriate testing method.  |
| <b>CO2</b> | Analyze the Testing tool for various applications.                                     |
| <b>CO3</b> | Design test-cases and automate testing using testing tool for a real-time application. |
| <b>CO4</b> | Demonstrate teamwork and problem-solving skills in project development.                |



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**CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 3   |     |     |     |     |     |     |     |     |      |      | 3    |      |      |
| <b>CO2</b> |     | 3   |     |     | 3   |     |     |     |     |      |      | 3    |      |      |
| <b>CO3</b> |     |     | 3   |     | 3   |     |     |     |     |      |      | 3    |      |      |
| <b>CO4</b> |     |     |     |     |     |     |     | 2   | 2   | 3    |      |      |      |      |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>            | <b>Marks</b> |
|----------------------------------------|---------------------------|--------------|
| <b>Internals</b>                       | ---                       | ---          |
| <b>Quiz</b>                            | ---                       | ---          |
| <b>Lab Component</b>                   | <b>CIE + Mini Project</b> | <b>50</b>    |
| <b>Alternate Assessment Tool (AAT)</b> | ---                       | ---          |
| <b>Total</b>                           |                           | <b>50</b>    |

**Weekly Activities and Delivery:**

| <b>Sl. No.</b> | <b>Week</b>     | <b>Activity</b>                                                                                                                                                                 | <b>Content Deliverables by the Assigned Teacher</b> | <b>Technologies / Skills to be Covered</b> |
|----------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--------------------------------------------|
| 1              | 1 <sup>st</sup> | Analyze the selenium tool and its usage in various application                                                                                                                  | Selenium Basics                                     | Study of Web Testing tool Selenium         |
| 2              | 2 <sup>nd</sup> | Consider a Bank application and study its system specifications and report the various bugs. Derive different test cases, execute these test cases and discuss the test results | Test-case generation                                | Selenium                                   |
| 3              | 3 <sup>rd</sup> | Design Test Case for Inventory Management system (For Project): Formation of groups to be done. Note: Student groups of size 3 or 4                                             | To give scenarios for designing Test-cases          | Selenium                                   |



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|   |                                                                                                            |                                                                                                           |                                             |                                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | 4 <sup>th</sup> , 5 <sup>th</sup><br>and<br>6 <sup>th</sup>                                                | Project topic selection by each Group. Presentation: Student and Project topic introduction by each group | Review the topics                           | Develop a Mini Project with documentation of suitable test-cases and their results to perform automation testing of any real time application (Eg: E-commerce, social media web page)                                                                                                                                                                                                        |
| 5 | 7 <sup>th</sup> ,<br>8 <sup>th</sup> ,<br>9 <sup>th</sup> ,<br>10 <sup>th</sup><br>and<br>11 <sup>th</sup> | Presentation by each group                                                                                | Review and Feedback                         | Suggested Guidelines: <ul style="list-style-type: none"><li>• Create a WebDriver session.</li><li>• Navigate to a Web page.</li><li>• Locate the web elements on the navigated page.</li><li>• Perform an action on the located elements.</li><li>• Assert the performed actions did the correct thing.</li><li>• Report the results of the assertions.</li><li>• End the session.</li></ul> |
| 6 | 12 <sup>th</sup>                                                                                           | Complete project work demonstration<br>Project report preparation                                         | Final Project Presentations and Submissions | Each inputs/data feed (ex: website, username, password, mobile no, product name, etc.,) must be provided through a file linked with code and neither to be entered manually nor to be included in the code Use any software testing tool like selenium, Katalon, etc.                                                                                                                        |

**Marks Distribution for the Course:**

**1) Continuous Evaluation through reviews - 40 Marks**

(Conducted for 40 Marks and reduced to 20 Marks)

**2) Mini-project - 60 Marks**



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|                      |                           |                             |           |
|----------------------|---------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>                  |                             |           |
| <b>Course Title:</b> | <b>Competitive Coding</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS5AECCO</b>         | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-0-1</b>              | <b>Total Credits:</b>       | <b>1</b>  |

**Introduction:**

This course focuses on Competitive Coding with the focus on modelling and implementing for real world problems.

- i. This course will deepen the understanding of problem-solving skills that students have learnt in the previous courses such as Data Structures and Algorithms.
- ii. Students will get confidence in hands-on problem-solving skill and will help in preparing for interviews, Hackathons, Google Talent Search, ACM ICPC.
- iii. Competitive Programming Strategies such as Problem formulation, Time Complexity and Space Complexity analysis, Handling input/output efficiently especially for large datasets.
- iv. The main objective of this course is to build a strong foundation in these areas through consistent practice and exploration of problem-solving techniques.

**Reference Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                                                                                | <b>Authors</b>                                                                    | <b>Edition</b>  | <b>Publisher</b>              | <b>Year</b> |
|----------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------|-------------------------------|-------------|
| 1.             | Introduction to Algorithms                                                                       | Thomas H. Cormen,<br>Charles E. Leiserson,<br>Ronald L. Rivest,<br>Clifford Stein | 3 <sup>rd</sup> | MIT Press                     | 2009        |
| 2.             | Competitive Programming 4<br>- Book 1: The Lower Bound<br>of Programming Contests in<br>the 2020 | Steven Halim,<br>Felix Halim,<br>Suhendry Effendy                                 | 1 <sup>st</sup> | Lulu.com                      | 2020        |
| 3.             | Competitive Programming 4<br>- Book 2: The Lower Bound<br>of Programming Contests in<br>the 2020 | Steven Halim,<br>Felix Halim,<br>Suhendry Effendy                                 | 1 <sup>st</sup> | Lulu.com                      | 2020        |
| 4.             | Elements of Programming<br>Interviews: The Insiders'<br>Guide                                    | Adnan Aziz,<br>Tsung-Hsien Lee,<br>Amit Prakash                                   | 2 <sup>nd</sup> | Amazon<br>Digital<br>Services | 2016        |
| 5.             | Cracking the Coding<br>Interview: 189 Programming<br>Questions and Solutions                     | Gayle Laakmann<br>McDowell                                                        | 6 <sup>th</sup> | HYESHOM                       | 2019        |



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**MOOC Courses:**

| Sl. No. | Course name                                  | Course Offered By | Year | URL                                                                                                                                                                   |
|---------|----------------------------------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Getting Started with Competitive Programming | NPTEL             | 2022 | <a href="https://onlinecourses.nptel.ac.in/noc22_cs59/preview">https://onlinecourses.nptel.ac.in/noc22_cs59/preview</a>                                               |
| 2       | Competitive Programming                      | Udemy             | 2022 | <a href="https://www.udemy.com/course/competitive-programming/?couponCode=ACCAGE0923">https://www.udemy.com/course/competitive-programming/?couponCode=ACCAGE0923</a> |

**Course Outcomes (COs):**

|            |                                                                                                      |
|------------|------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Analyse complex problems using efficient algorithms and data structures                              |
| <b>CO2</b> | Design and implement various problems of different levels of complexity using algorithmic techniques |

**CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |     |     | 3   |     |     |     |     |     |     |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                                   | Remarks               | Marks     |
|----------------------------------------|-----------------------|-----------|
| <b>Internals</b>                       | ---                   | ---       |
| <b>Quiz</b>                            | ---                   | ---       |
| <b>Lab Component</b>                   | <b>CIE + Lab Test</b> | <b>50</b> |
| <b>Alternate Assessment Tool (AAT)</b> | ---                   | ---       |
| <b>Total</b>                           |                       | <b>50</b> |

**Laboratory Plan:**

- Students must take an online test based on topics such as Data Structures and Algorithms every week on the online platform provided by the institution.
- Teacher Guidance:** The teacher allotted should teach students various Algorithmic techniques and evaluate the progress and final outcomes of the assigned students.
- CIE Evaluation will be done for 100 marks and will be reduced to 50 marks.  
**Final CIE marks (50)** will be allotted as follow: Regular lab (15 marks) + Test (35 marks)

**SEE Exam (50 Marks):**

Online Test will be conducted in the online platform provided by the Institution and evaluated.



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|                      |                       |                             |           |
|----------------------|-----------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>              |                             |           |
| <b>Course Title:</b> | <b>DevOps - Tools</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS5AEDOP</b>     | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-0-1</b>          | <b>Total Credits:</b>       | <b>1</b>  |

**Guidelines:**

- 1. DevOps Implementation on Previous Projects:** Under this project work, students should apply DevOps principles and tools to previously developed full stack applications, data science applications, or machine learning applications. This includes setting up version control, continuous integration, continuous deployment, and containerization.
- 2. Advanced Application Development:** Under this project work, students should extend their existing applications using technologies such as PHP, Python, Node.js, React, Angular, or any suitable front-end and back-end technologies, and integrate DevOps practices.
- 3. Group Formation:** Students can form a group with a minimum of two and a maximum of four members to collaborate on the DevOps implementation project.
- 4. Teacher Guidance:** The teacher allotted for project work should teach students various DevOps tools such as Git, GitHub, Docker, Jenkins, GitHub Actions, etc., during class/lab hours as per the allotment. The teacher should guide the students in choosing the appropriate DevOps strategies and tools, assist them in applying these tools to their projects, and evaluate the progress and final outcomes of the assigned students.

**Reference Text Books:**

| <b>Sl. No</b> | <b>Book Title</b>                        | <b>Authors</b>                                                              | <b>Edition</b>  | <b>Publisher</b>    | <b>Year</b> |
|---------------|------------------------------------------|-----------------------------------------------------------------------------|-----------------|---------------------|-------------|
| 1             | A Beginners guide to DevOps Basics       | Swatee Chand                                                                | 1 <sup>st</sup> | Edureka             | 2022        |
| 2             | The DevOPS Handbook: How to Create World | Gene Kim,<br>Jez Humble,<br>Patrick Debois,<br>John Allspaw,<br>John Willis | 2 <sup>nd</sup> | It Revolution Press | 2021        |

**Tutorial Links:**

1. <https://www.coursera.org/learn/intro-to-devops>
2. <https://www.udacity.com/course/intro-to-devops--ud611>
3. <https://www.classcentral.com/subject/devops>

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Course Outcomes (COs):**

|            |                                                                                                                       |
|------------|-----------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Implement version control systems and manage code repositories effectively, along with containerization using Docker. |
| <b>CO2</b> | Design and implement CI/CD pipelines for automated testing, integration, and deployment.                              |
| <b>CO3</b> | Participate effectively in team projects, deliver clear presentations, and create well-structured reports.            |

**CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3      | PO4 | PO5      | PO6 | PO7 | PO8      | PO9      | PO10     | PO11 | PSO1     | PSO2 | PSO3 |
|------------|-----|-----|----------|-----|----------|-----|-----|----------|----------|----------|------|----------|------|------|
| <b>CO1</b> |     |     |          |     | <b>3</b> |     |     |          |          |          |      | <b>3</b> |      |      |
| <b>CO2</b> |     |     | <b>3</b> |     | <b>3</b> |     |     |          |          | <b>2</b> |      | <b>3</b> |      |      |
| <b>CO3</b> |     |     |          |     |          |     |     | <b>3</b> | <b>3</b> |          |      |          |      |      |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>             | <b>Marks</b> |
|----------------------------------------|----------------------------|--------------|
| <b>Internals</b>                       | ---                        | ---          |
| <b>Quiz</b>                            | ---                        | ---          |
| <b>Lab Component</b>                   | <b>CIE through Reviews</b> | <b>50</b>    |
| <b>Alternate Assessment Tool (AAT)</b> | ----                       | --           |
| <b>Total</b>                           |                            | <b>50</b>    |

**Laboratory Plan:**

| <b>Sl. No.</b> | <b>Week</b>     | <b>Activity</b>                                                                                              | <b>Content Deliverables by the Assigned Teacher</b> | <b>Technologies/Skills to be Covered</b>                                                           |
|----------------|-----------------|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------|
| 1              | 1 <sup>st</sup> | Formation of groups. Note: Student groups of size 2 or 3 or 4                                                | Introduction to DevOps and Project Setup            | Overview of DevOps principles and tools, Introduction to version control using Git                 |
| 2              | 2 <sup>nd</sup> | Project topic selection by each Group.<br>Presentation: Student and Project topic introduction by each group | Version Control and Repository Setup                | Creating and managing repositories on GitHub, Branching and merging strategies, Basic Git commands |



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|   |                                                       |                                     |                                             |                                                                                                                                                     |
|---|-------------------------------------------------------|-------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | 3 <sup>rd</sup>                                       | Initial project setup               | Containerization Basics                     | Introduction to Docker, Writing Dockerfiles, Building and running Docker containers                                                                 |
| 4 | 4 <sup>th</sup> , 5 <sup>th</sup> and 6 <sup>th</sup> | Frontend and backend development    | Advanced Docker Techniques                  | Multi-stage builds, Docker Compose for multi-container applications, Managing data volumes and networks                                             |
| 5 | 7 <sup>th</sup> , 8 <sup>th</sup> and 9 <sup>th</sup> | CI/CD Pipeline Setup                | Continuous Integration and Deployment       | Setting up CI/CD pipelines using GitHub Actions or Jenkins, Automated testing and deployment, Integrating with Docker                               |
| 6 | 10 <sup>th</sup>                                      | Presentation by each group          | Mid-term Review and Feedback                | Review of CI/CD pipeline implementations, Providing feedback for improvement, Troubleshooting CI/CD issues                                          |
| 7 | 11 <sup>th</sup>                                      | Complete project work demonstration | Continuous Deployment Strategies            | Deploying applications to free cloud hosting providers (Heroku, Netlify, etc.), Rollback strategies, Monitoring deployments                         |
| 8 | 12 <sup>th</sup>                                      | Project report preparation          | Final Project Presentations and Submissions | Comprehensive report on DevOps implementation, Demonstrating CI/CD pipelines, Containerization and deployment strategies, Best practices for DevOps |



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|                      |                     |                             |           |
|----------------------|---------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>5</b>            |                             |           |
| <b>Course Title:</b> | <b>Mini Project</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS5PWMIP</b>   | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>0-0-2</b>        | <b>Total Credits:</b>       | <b>2</b>  |

**Guidelines:**

- Implementation of Research Papers: Under this mini project work student should refer recent Journal papers, transaction papers [IEEE, Springer, Elsevier, etc.] of interested domain, implement the algorithms and technologies mentioned in the paper.
- Students can form a group with team size 3 to 4.
- Teacher allotted for mini project work should guide the students on the topic selected and towards carrying out mini project work and complete the evaluation of assigned students.
- Continuous evaluation of the project is carried out by the faculty and the final CIE is calculated as the sum of the 3 reviews conducted.

**Course Outcomes (COs):**

|            |                                                                                                                             |
|------------|-----------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Analyze the research techniques and algorithms mentioned in the technical paper.                                            |
| <b>CO2</b> | Design and develop a mini project using their domain knowledge and technologies to solve societal and engineering problems. |
| <b>CO3</b> | Document and present the implemented solutions in a team.                                                                   |

**CO-PO-PSO mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 |     | 2   |     | 2   |     |     |     |     |     |      |      |      |      |      |
| CO2 |     |     | 3   |     | 3   | 2   |     |     |     |      |      | 1    | 2    | 1    |
| CO3 |     |     |     |     |     |     | 2   | 2   | 2   |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                                   | Remarks                    | Marks     |
|----------------------------------------|----------------------------|-----------|
| <b>Internals</b>                       | ---                        | ---       |
| <b>QUIZ</b>                            | ---                        | ---       |
| <b>Lab Component</b>                   | <b>CIE through Reviews</b> | <b>50</b> |
| <b>Alternate Assessment Tool (AAT)</b> | ---                        | ---       |
| <b>Total</b>                           |                            | <b>50</b> |



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**Weekly Activities and Delivery:**

| Sl. No | Week                                                  | Activity                                                                   | Content deliverables by the assigned teacher                                       |
|--------|-------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 1      | 1 <sup>st</sup>                                       | Formation of groups.<br>Note: Student groups of size 3 or 4                | Introduction to research process and domain for selecting technical paper.         |
| 2      | 2 <sup>nd</sup>                                       | Project topic selection by each group                                      | Discuss the techniques/algorithms mentioned in the referred paper.                 |
| 3      | 3 <sup>rd</sup>                                       | Presentation: Student and Project topic introduction by each group         | Verify the study of existing system and proposed system techniques from the paper. |
| 4      | 4 <sup>th</sup> , 5 <sup>th</sup> and 6 <sup>th</sup> | 25% of the project work carried out                                        | Review the work carried out.                                                       |
| 5      | 7 <sup>th</sup>                                       | Presentation on the working model of the proposed work (25%) by each group | Review the work carried out.                                                       |
| 6      | 8 <sup>th</sup> and 9 <sup>th</sup>                   | 50% of the project work carried out                                        | Review the complete work.                                                          |
| 7      | 10 <sup>th</sup>                                      | Discussion on Results of the complete work carried out                     | Validation of all the results obtained.                                            |
| 8      | 11 <sup>th</sup>                                      | Complete project work carried out with relevant modules and features       | Final Presentation and evaluation.                                                 |
| 9      | 12 <sup>th</sup>                                      | Project Report Preparation and plagiarism report                           | ---                                                                                |

**Rubrics for Mini Project Evaluation:**

| Criteria                           | Exemplary                                                                                                                                                                                              | Proficient                                                                                                              | Partially Proficient                                                                                                                                 | Points |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Problem Formulation and Objectives | (10-8)<br>Problem formulation and all objectives of the proposed work are well defined. Steps to be followed to solve the defined problem are clearly specified. The proposed solution is sustainable. | (7-4)<br>Incomplete Problem formulation and justification to the objectives proposed. Steps are mentioned, but unclear. | (3-1)<br>Problem formulation and objectives of the proposed work are either not identified or not well defined Incomplete and improper specification | ___/10 |



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|                                           |                                                                                                                                                                                |                                                                                                                                                                          |                                                                                                  |        |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------|
| Analyze the algorithms and techniques     | (10-8)<br>All algorithms / techniques are analyzed appropriately in accordance to the requirements.                                                                            | (7-4)<br>All algorithms / techniques are analyzed moderately in accordance to the requirements.                                                                          | (3-1)<br>Some of the algorithms / techniques are not analyzed in accordance to the requirements. | ___/10 |
| Design of the modules for the application | (20-16)<br>All modules are designed appropriately in accordance to the requirements.                                                                                           | (15-8)<br>All modules are designed moderately in accordance to the requirements.                                                                                         | (7-1)<br>Some of the modules are not designed in accordance to the requirements.                 | ___/20 |
| Technical Implementation                  | (15-10)<br>Implementation of modules using appropriate features for all set objectives showcasing efficiency, integrity, scalability, sustainability and technical excellence. | (9-6)<br>Implementation of modules using appropriate features for most of the set objectives showcasing integrity, scalability, sustainability and technical excellence. | (5-1)<br>Some of the modules are implemented in accordance with the design.                      | ___/15 |
| Demonstration of the project              | (10-8)<br>Demonstrates the functionality of the application using appropriate reports or results for various cases.                                                            | (7-4)<br>Demonstrates the functionality of the application using appropriate reports or results for few cases.                                                           | (3-1)<br>Demonstrates the functionality of the application without much reporting or results.    | ___/10 |
| Group Participation (10)                  | (10-8)<br>Exhibits active engagement, exceptional collaboration, and effective teamwork throughout the project lifecycle.                                                      | (7-4)<br>Consistent participation and constructive collaboration within the group.                                                                                       | (3-1)<br>Minimal but noticeable participation and occasional contributions.                      | ___/10 |



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|                               |                                                                                                                                              |                                                                                                                                                                              |                                                                                                                                                 |                |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Presentation                  | (10-8)<br>Professional, engaging presentation with outstanding visuals and comprehensive content, demonstrating exceptional delivery skills. | (7-4)<br>Well-structured presentation with clear content and effective delivery.                                                                                             | (3-1)<br>Basic presentation with some structure and varying delivery quality.                                                                   | ___/10         |
| Project and plagiarism report | (15-12)<br>Clear and Effective writing and adherence to appropriate style guidelines and percentage of plagiarism $\leq 20$ .                | (11-6)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines and percentage of plagiarism between 20 to 40. | (5-1)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines and percentage of plagiarism $> 40$ . | ___/15         |
| <b>Total</b>                  |                                                                                                                                              |                                                                                                                                                                              |                                                                                                                                                 | <b>___/100</b> |

**Note:** CIE will be conducted for 100 marks and reduced to 50 marks.



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# **6<sup>th</sup>**

# **Semester**



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|                      |                 |                             |    |
|----------------------|-----------------|-----------------------------|----|
| <b>Semester:</b>     | 6               |                             |    |
| <b>Course Title:</b> | Cloud Computing |                             |    |
| <b>Course Code:</b>  | 23CS6PCCCT      | <b>Total Contact Hours:</b> | 28 |
| <b>L-T-P:</b>        | 2-1-0           | <b>Total Credits:</b>       | 3  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                               | Hours |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to Cloud Computing:</b> Defining Cloud Computing, Cloud Types, The NIST model, Deployment models, Service models, Characteristics of Cloud Computing, Benefits of cloud computing, Disadvantages of cloud computing                                                                                                                                                                                                                  | 5     |
| 2        | <b>Understanding Abstraction and Virtualization:</b> Using Virtualization Technologies, Load Balancing and Virtualization, Understanding Hypervisors, VMware vSphere, Understanding Machine Imaging, Capacity Planning, Defining Baseline and Metrics: Baseline measurements                                                                                                                                                                         | 5     |
| 3        | <b>Web Services:</b> Understanding Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2), Working with Amazon Storage Systems, Understanding Amazon Database Services.<br><b>Exploring Platform as a Service:</b> Defining Services Salesforce.com versus Force.com: SaaS versus PaaS Application development                                                                                | 6     |
| 4        | <b>Understanding Cloud Security:</b> Securing the Cloud The security boundary Security service boundary Security mapping Securing Data Brokered cloud storage access Storage location and tenancy Encryption Auditing and compliance<br><b>Moving Applications to the Cloud:</b> Applications in the Clouds, Functionality mapping, Application attributes, Cloud service attributes, System abstraction, Cloud bursting, Applications and Cloud API | 6     |
| 5        | <b>Kubernetes:</b> Understanding Kubernetes architecture, Kubernetes Concepts, Kubernetes architecture, The Kubernetes APIs<br><b>Microservices:</b> The Truth About Monoliths, What Are Microservices and How Do They Relate to Event-Driven, SOA, Microservice, and Event-Driven Architectures, Moving from a Monolith to an Event-Driven Architecture                                                                                             | 6     |



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**Prescribed Text Books:**

| Sl. No. | Book Title            | Authors                          | Edition         | Publisher              | Year |
|---------|-----------------------|----------------------------------|-----------------|------------------------|------|
| 1       | Cloud Computing Bible | Barrie Sosinsky                  | 1 <sup>st</sup> | Wiley Publishing, Inc. | 2011 |
| 2       | Mastering Docker      | Scott Gallagher, Russ McKendrick | 2 <sup>nd</sup> | Packt                  | 2017 |
| 3       | Mastering Kubernetes  | Gigi Sayfan                      | 3 <sup>rd</sup> | Packt                  | 2020 |

**Reference Text Books:**

| Sl. No. | Book Title                               | Author                                           | Edition         | Publisher     | Year |
|---------|------------------------------------------|--------------------------------------------------|-----------------|---------------|------|
| 1       | Cloud Computing: Theory and Practice     | Dan C Marinescu                                  | 1 <sup>st</sup> | Elsevier (MK) | 2013 |
| 2       | Cloud Computing Principles and Paradigms | Rajkumar Buyya, James Broberg, Andrzej Goscinski | 1 <sup>st</sup> | Wiley         | 2014 |

**E-Book:**

| Sl. No. | Book Title                          | Authors                         | Edition         | Publisher        | Year | URL                                                                                                                                                                                                                                             |
|---------|-------------------------------------|---------------------------------|-----------------|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Cloud Computing a Hands on Approach | Arshdeep Bahga, Vijay Madisetti | 1 <sup>st</sup> | University Press | 2013 | <a href="https://pdfcoffee.com/qdownload/cloud-computing-a-hands-on-approach-arshdeep-bahga-vijay-madisetti-pdf-free.html">https://pdfcoffee.com/qdownload/cloud-computing-a-hands-on-approach-arshdeep-bahga-vijay-madisetti-pdf-free.html</a> |

**MOOC Courses:**

| Sl. No | Course name                     | Course Offered By | Year | URL                                                                                                                                                 |
|--------|---------------------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Introduction to Cloud Computing | Coursera          | 2023 | <a href="https://www.coursera.org/learn/introduction-to-cloud?action=enroll">https://www.coursera.org/learn/introduction-to-cloud?action=enroll</a> |
| 2      | Cloud Computing                 | NPTEL             | 2023 | <a href="https://onlinecourses.nptel.ac.in/noc23_cs89/preview">https://onlinecourses.nptel.ac.in/noc23_cs89/preview</a>                             |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Course Outcomes (COs):**

|            |                                                                      |
|------------|----------------------------------------------------------------------|
| <b>CO1</b> | Apply fundamental concepts of Cloud Computing.                       |
| <b>CO2</b> | Analyse technological concepts of Cloud Computing.                   |
| <b>CO3</b> | Design and development of cloud application using appropriate tools. |

**CO-PO-PSO mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5      | PO6 | PO7 | PO8      | PO9      | PO10 | PO11 | PSO1 | PSO2 | PSO3     |
|------------|----------|----------|----------|-----|----------|-----|-----|----------|----------|------|------|------|------|----------|
| <b>CO1</b> | <b>3</b> |          |          |     |          |     |     |          |          |      |      |      |      |          |
| <b>CO2</b> |          | <b>3</b> |          |     |          |     |     |          |          |      |      |      |      |          |
| <b>CO3</b> |          |          | <b>2</b> |     | <b>2</b> |     |     | <b>2</b> | <b>2</b> |      |      |      |      | <b>3</b> |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>     | <b>Marks</b> |
|----------------------------------------|--------------------|--------------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b>    |
| <b>Quiz</b>                            | -                  | -            |
| <b>Lab Component</b>                   | -                  | -            |
| <b>Alternate Assessment Tool (AAT)</b> | <b>ONE</b>         | <b>10</b>    |
| <b>Total</b>                           |                    | <b>50</b>    |

**AAT Plan:**

Cloud Computing AAT valuation will be as follows:

- The Continuous valuation will be conducted for 50 marks and reduced to 10 marks.
- The proposed AAT plan has two parts A and B
- Part A carries 10 marks and Part B carries 40 marks
- Part A+B=50 marks which will be further reduced to 10 marks.
- The split is as follows

Part A:

- The break up of 10 marks is as follows:
- The programs in the tutorials will be considered for weekly valuation as a part of continuous evaluation as follows:



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| Program number | Unit | Topic                                                                                                                                                      | Marks    |
|----------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1              | 1    | Demonstration of SaaS application(Demonstrate CRM application suitable platform)                                                                           | 10       |
| 2              | 3    | Demonstration of SaaS application(Demonstrate CRM application suitable platform)                                                                           | 10       |
| 3              | 2    | a. Create a virtual machine using VMWare Workstation PRO12 (VMware PlayStation)<br>b. Install Python to create a virtual machine and run a simple program. | 10       |
| 4              | 2    | Installation of CloudSim Simulator                                                                                                                         | 10       |
| 5              | 2    | Demonstration and program implementation on CloudSim Simulator                                                                                             | 10       |
| 6              | 5    | Demonstration of Dockers and Kubernetes.                                                                                                                   | 10       |
| 7              | 3    | Introduction to Cloud Course on AWS Educate                                                                                                                | 10       |
| 8              | 4    | Getting Started with Security on AWS Educate                                                                                                               | 10       |
| 9              | 2    | Getting Started with Compute on AWS Educate                                                                                                                | 10       |
| 10             | 5    | Complete Getting Started with Serverless on AWS Educate                                                                                                    | 10       |
| Average marks: |      |                                                                                                                                                            | 10 Marks |

**2.Part B**

- The AAT is to be carried out in a group of 5 to 6 members.
- The students have to work on the below problem statement

**Problem Statement:**

Create an application for data analysis (Use any front-end tool and NoSQL Database as backend), Dockerize the same and host it on a chosen cloud (AWS, Google cloud etc)



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Its rubrics for 40 marks are as follows:

**Rubrics used for AAT evaluation:**

| Criteria                     | Exemplary                                                                                                      | Proficient                                                                                              | Partially Proficient                                                                                 | Points                                                             |          |
|------------------------------|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|----------|
| Problem statement selection  | The team selects a topic which is complex and have good potential for data analysis [10 Marks]                 | The team selects a topic which is has good potential for data analysis [7 Marks]                        | The team selects a topic which poor potential for data analysis [3 Marks]                            | The team is unable to get a problem statement [10 Marks]           | -/10     |
| Report                       | The team submits a soft copy of the report and produces a video recording of the working application [5 Marks] | The team submits produces a video recording of the working application only without the report [3Marks] | The team submits a soft copy of the report only [1 Marks]                                            | No report nor video recording of the working application [0 Marks] | -/5      |
| Execution and Implementation | The team is able to execute the problem statement and have a fully functionally running application [25 Marks] | The team is able to execute the problem statement and have running application [15 Marks]               | The team is able to partially execute the problem statement and have a running application [5 Marks] | The team is unable to execute the problem statement [0 Marks]      | -/25     |
| Total                        | -                                                                                                              | -                                                                                                       | -                                                                                                    | -                                                                  | 40 Marks |

Note: AAT will be evaluated for 50 marks and reduced to 10 marks.



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|                      |                    |                             |    |
|----------------------|--------------------|-----------------------------|----|
| <b>Semester:</b>     | 6                  |                             |    |
| <b>Course Title:</b> | Big Data Analytics |                             |    |
| <b>Course Code:</b>  | 23CS6PCBDA         | <b>Total Contact Hours:</b> | 42 |
| <b>L-T-P:</b>        | 3-0-1              | <b>Total Credits:</b>       | 4  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Hours |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction to Big Data and Analytics:</b> Types of Digital Data, Definition of Big data and Analytics, Characteristics of Big Data, Domain Specific Examples of Big Data, Analytics Flow for Big Data, Big Data Stack, Mapping Analytics Flow to Big Data Stack, Case Study: Weather Data Analysis                                                                                                                                                                                                                                                            | 8     |
| 2        | <b>CAP theorem, NoSQL:</b> Types of NoSQL databases, MongoDB– Terms used in RDBMS and MongoDB, MongoDB Query Language: CRUD (Create, Read, Update and Delete) operations, Finding documents based on search criteria, Dealing with Null values , Count, Limit, Sort Skip, Aggregate Functions                                                                                                                                                                                                                                                                      | 8     |
| 3        | <b>Cassandra</b> –Features of Cassandra, Keyspaces, CRUD, Collection, Counters, Time to Live (TTL) operations, Practice Examples. <b>Hadoop:</b> Introducing Hadoop, RDBMS verses Hadoop, Distributed Computing Challenges                                                                                                                                                                                                                                                                                                                                         | 8     |
| 4        | <b>Hadoop Overview, Big Data Storage:</b> HDFS, Batch Analysis: Hadoop and MapReduce, Wordcount Demonstration, Hadoop- MapReduce Examples.                                                                                                                                                                                                                                                                                                                                                                                                                         | 9     |
| 5        | <b>Scala:</b> The Basics, Control Structures and functions, Working with arrays, Maps and Tuples.<br><b>Introduction to Data Analysis with Spark:</b> Introduction to Apache Spark, A unified Spark, Users of Spark, Storage layers for Spark. Programming with RDDs: RDD Basics, Creating RDDs, RDD Operations, Passing functions to Spark, Common Transformations and Actions, Persistence. <b>Spark SQL:</b> Linking with Spark SQL, Using Spark SQL in Applications, Loading and Saving Data, JDBC/ODBC Server, User-defined functions, Spark SQL Performance. | 9     |

**Prescribed Text Books:**

| Sl. No. | Book Title                                         | Authors                              | Edition         | Publisher                   | Year |
|---------|----------------------------------------------------|--------------------------------------|-----------------|-----------------------------|------|
| 1       | Big Data Science & Analytics – A Hands-on Approach | Arshdeep Bahga, Vijay Madisetti      | 1 <sup>st</sup> |                             | 2018 |
| 2       | Big Data and Analytics                             | Seema Acharya, Subjashini Chellappan | 1 <sup>st</sup> | Wiley                       | 2010 |
| 3       | Scala for the Impatient                            | Cay S. Horstmann                     | 2 <sup>nd</sup> | Addison-Wesley Professional | 2016 |



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|   |                                                       |                                                                       |                 |          |      |
|---|-------------------------------------------------------|-----------------------------------------------------------------------|-----------------|----------|------|
| 4 | Learning Spark<br>Lightning-Fast Big Data<br>Analysis | Andy Konwinski,<br>Holden Karau,<br>Matei Zaharia, Patrick<br>Wendell | 1 <sup>st</sup> | O'Reilly | 2015 |
|---|-------------------------------------------------------|-----------------------------------------------------------------------|-----------------|----------|------|

**Reference Text Books:**

| Sl. No. | Book Title                                                              | Author                                                                                 | Edition         | Publisher    | Year |
|---------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------|--------------|------|
| 1       | A Textbook on Big Data Analytics                                        | Dr. V. Harsha Shastri,<br>Mrs. V Sreeprada,<br>Mr. T. Udhayakumar,<br>Dr. K. R. Ananth | 1 <sup>st</sup> | Notion Press | 2023 |
| 2       | Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning | Raj Kamal,<br>Preeti Saxena                                                            | 1 <sup>st</sup> | McGraw Hill  | 2019 |

**E-Book:**

| Sl. No. | Book Title                         | Authors                                                              | Edition         | Publisher                                  | Year | URL                                                                                                                                                         |
|---------|------------------------------------|----------------------------------------------------------------------|-----------------|--------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Introduction To Big Data Analytics | Dr. John T Mesia Dhas,<br>Dr. T. S. Shiny Angel,<br>Dr. Adarsh T. K. | 1 <sup>st</sup> | Self-published by<br>Dr. John T Mesia Dhas | 2022 | <a href="https://www.ijaeast.com/Introduction%20to%20Big%20Data%20Analytics.pdf">https://www.ijaeast.com/Introduction%20to%20Big%20Data%20Analytics.pdf</a> |

**MOOC Courses:**

| Sl. No. | Course name        | Course Offered By | Year | URL                                                                                       |
|---------|--------------------|-------------------|------|-------------------------------------------------------------------------------------------|
| 1       | Hadoop Starter Kit | Udemy             | 2024 | Free Hadoop Tutorial - Hadoop Starter Kit   Udemy                                         |
| 2       | Big Data Computing | NPTEL             | 2024 | <a href="https://nptel.ac.in/courses/106104189">https://nptel.ac.in/courses/106104189</a> |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Course Outcomes (COs):**

|            |                                                                                                  |
|------------|--------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concept of NoSQL, Hadoop, Spark for a given task                                       |
| <b>CO2</b> | Analyse big data analytics mechanisms that can be applied to obtain solution for a given problem |
| <b>CO3</b> | Design and implement solutions using big data analytics mechanisms for a given problem.          |
| <b>CO4</b> | Demonstrate commands to manipulate and query data in NoSQL and Big Data Framework                |

**CO-PO-PSO mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5      | PO6      | PO7 | PO8      | PO9      | PO10 | PO11 | PSO1 | PSO2     | PSO3     |
|------------|----------|----------|----------|-----|----------|----------|-----|----------|----------|------|------|------|----------|----------|
| <b>CO1</b> | <b>3</b> |          |          |     |          |          |     |          |          |      |      |      |          |          |
| <b>CO2</b> |          | <b>3</b> |          |     |          |          |     |          |          |      |      |      |          |          |
| <b>CO3</b> |          |          | <b>3</b> |     |          | <b>2</b> |     | <b>3</b> | <b>3</b> |      |      |      |          | <b>2</b> |
| <b>CO4</b> |          |          |          |     | <b>3</b> |          |     |          |          |      |      |      | <b>2</b> |          |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>        | <b>Marks</b> |
|----------------------------------------|-----------------------|--------------|
| <b>Internals</b>                       | <b>Best 2 of 3</b>    | <b>20</b>    |
| <b>Quiz</b>                            | -                     | -            |
| <b>Lab Component</b>                   | <b>CIE + Lab Test</b> | <b>25</b>    |
| <b>Alternate Assessment Tool (AAT)</b> | <b>ONE</b>            | <b>05</b>    |
| <b>Total</b>                           |                       | <b>50</b>    |

**Laboratory Plan:****Instructions to Students:**

1. Students should write the program then start with the program execution for that week to be executed in the lab at the beginning of each lab and get it corrected by the batch-in-charge faculty.
2. Soft copy (PDF file) of all the programs along with the output needs to be submitted before the lab test.
3. Continuous Internal Evaluation for each lab is for 10 marks which includes execution of the program in the allotted lab time and showing the output. Observation book needs to be corrected on the same day itself.
4. One Lab Test will be conducted (Mostly after theory Test-2) for all the 10 programs. Lab Test will comprise programs which are completely different from the existing lab list of programs.

5. Marks split up for Lab:

Continuous Internal Evaluation: **100 marks à reduced to 10 marks**



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Lab Test: **60 marks → reduced to 15 marks** (Writeup- 20 marks, Execution- 30 marks, Viva- 10 marks)

**Lab Programs:**

| Lab Program | Unit # | Marks for Continuous Evaluation | Program Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|--------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1           | 2      | 10                              | MongoDB- CRUD Operations Demonstration (Practice and Self Study)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 2           | 3      | 10                              | <p>Perform the following DB operations using Cassandra.</p> <ul style="list-style-type: none"> <li>a) Create a keyspace by name Employee</li> <li>b) Create a column family by name Employee-Info with attributes<br/>Emp_Id Primary Key, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name</li> <li>c) Insert the values into the table in batch</li> <li>d) Update Employee name and Department of Emp-Id 121</li> <li>e) Sort the details of Employee records based on salary</li> <li>f) Alter the schema of the table Employee_Info to add a column Projects which stores a set of Projects done by the corresponding Employee.</li> <li>g) Update the altered table to add project names.</li> <li>h) Create a TTL of 15 seconds to display the values of Employees.</li> </ul> |
| 3           | 3      | 10                              | <p>Perform the following DB operations using Cassandra.</p> <ul style="list-style-type: none"> <li>a) Create a keyspace by name Library</li> <li>b) Create a column family by name Library-Info with attributes<br/>Stud_Id Primary Key, Counter_value of type Counter, Stud_Name, Book-Name, Book-Id, Date_of_issue</li> <li>c) Insert the values into the table in batch</li> <li>d) Display the details of the table created and increase the value of the counter</li> <li>e) Write a query to show that a student with id 112 has taken a book “BDA” 2 times.</li> <li>f) Export the created column to a csv file</li> <li>g) Import a given csv dataset from local file system into Cassandra column family</li> </ul>                                                                  |



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|    |   |    |                                                                                                                                                                                                                                                                                                                                                             |
|----|---|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4  | 4 | 10 | Execution of HDFS Commands for interaction with Hadoop Environment. (Minimum 10 commands to be executed)                                                                                                                                                                                                                                                    |
| 5  | 4 | 10 | Implement Wordcount program on Hadoop framework                                                                                                                                                                                                                                                                                                             |
| 6  | 4 | 10 | From the following link extract the weather data<br><a href="https://github.com/tomwhite/hadoop-book/tree/master/input/ncdc/all">https://github.com/tomwhite/hadoop-book/tree/master/input/ncdc/all</a><br>a) Create a MapReduce program to find average temperature for each year from NCDC data set.<br>b) find the mean max temperature for every month. |
| 7  | 4 | 10 | For a given Text file, Create a Map Reduce program to sort the content in an alphabetic order listing only top 10 maximum occurrences of words.                                                                                                                                                                                                             |
| 8  | 5 | 10 | Write a Scala program to print numbers from 1 to 100 using for loop.                                                                                                                                                                                                                                                                                        |
| 9  | 5 | 10 | Using RDD and FlatMap count how many times each word appears in a file and write out a list of words whose count is strictly greater than 4 using Spark.                                                                                                                                                                                                    |
| 10 | 5 | 10 | Write a simple streaming program in Spark to receive text data streams on a particular port, perform basic text cleaning (like white space removal, stop words removal, lemmatization, etc.), and print the cleaned text on the screen. (Open Ended Question).                                                                                              |

**AAT Plan:**

Students have to solve the 5 open ended Questions assigned to them. The Questions will be chosen from the concepts that are covered in class.. To conclude they will have to present their solutions in a team of 2 and also submit a report.

**Students AAT group Plan of Activities:**

Following are the activities week-wise to be carried out by students during project work

| Sl. No | Week                                | Activity                                 | No. of hours for self learning |
|--------|-------------------------------------|------------------------------------------|--------------------------------|
| 1      | 1 <sup>st</sup> and 2 <sup>nd</sup> | Understanding of the Concepts of NoSQL . | --                             |
| 2      | 3 <sup>rd</sup> and 4 <sup>th</sup> | Implementation- Open Ended Question 1.   | 5                              |
| 3      | 5 <sup>th</sup> and 6 <sup>th</sup> | Implementation- Open Ended Question 2.   | 5                              |



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|    |                                       |                                                              |   |
|----|---------------------------------------|--------------------------------------------------------------|---|
| 4  | 7 <sup>th</sup> and 8 <sup>th</sup>   | Understanding of the Concepts of Hadoop and Spark Framework. | 5 |
| 5  | 9 <sup>th</sup> and 10 <sup>th</sup>  | Implementation- Open Ended Question 3.                       | 5 |
| 6  | 11 <sup>th</sup> and 12 <sup>th</sup> | Implementation- Open Ended Question 4.                       | 5 |
| 9  | 13 <sup>th</sup>                      | Implementation- Open Ended Question 5.                       | 4 |
| 10 | 14 <sup>th</sup>                      | Presentation and Project Report                              | 5 |

**Rubrics used for AAT evaluation:**

| Criteria                                    | Exemplary                                                                                                                 | Proficient                                                                                                        | Partially Proficient                                                                                        | Points  |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|---------|
| Implementation                              | (7-8)<br>Correct implementation of the Open Ended Question assigned with appropriate Schema, Syntax and coding mechanism. | (4-6)<br>Correct implementation of the Open Ended Question assigned.                                              | (0-3)<br>Code is not implemented in accordance with the Open Ended Question..                               | ___ / 8 |
| NoSql, Hadoop and Spark framework analysis. | (5-4)<br>Able to analyze completely the No-Sql database, Hadoop and Spark framework as per the output of the code.        | (3-2)<br>Able to analyze partially the No-Sql database, Hadoop and Spark framework as per the output of the code. | (1-0)<br>Not able to analyze the No-Sql database, Hadoop and Spark framework as per the output of the code. | ___ / 4 |
| Oral communication/ presentation            | (5-4)<br>Clear and effective communication. Answers all the questions                                                     | (3-2)<br>Communication is clear. Answered most of the questions                                                   | (1-0)<br>Unclear communication. Answered only few of the questions                                          | ___ / 4 |



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|        |                                                                           |                                                                                                           |                                                                                     |            |
|--------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------|
| Report | (5-4)<br>Clear and<br>Effective<br>writing and<br>adherence<br>to syntax. | (3-2)<br>Writing that is<br>clear and<br>effective for the<br>most part and<br>minor errors in<br>syntax. | (1-0)<br>Unclear and<br>ineffective<br>writing and<br>multiple errors<br>in syntax. | ___/4      |
| Total  |                                                                           |                                                                                                           |                                                                                     | ___/2<br>0 |

Note: AAT will be evaluated for 20 marks and reduced to 5 marks.



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|                      |                  |                             |    |
|----------------------|------------------|-----------------------------|----|
| <b>Semester:</b>     | 6                |                             |    |
| <b>Course Title:</b> | Machine Learning |                             |    |
| <b>Course Code:</b>  | 23CS6PCMAL       | <b>Total Contact Hours:</b> | 42 |
| <b>L-T-P:</b>        | 3-0-1            | <b>Total Credits:</b>       | 4  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                                                                                                          | Hours |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <b>Introduction To Machine Learning</b> - Machine learning Landscape: Purpose of Machine Learning, examples of applications, Types of ML, main challenges of ML, Testing & Validating End to end Machine learning Project: Working with real data, look at the big picture, Get the data, Discover, and visualize the data, Prepare the data, select, and train the model, Fine tune your model | 8     |
| 2        | <b>Supervised Learning:</b> Linear Regression, Multiple Linear Regression, Logistic Regression, K Nearest Neighbours, Decision Trees: ID3, Classification and Regression Trees, Support Vector Machines: Linear and Non-Linear, Kernel Functions                                                                                                                                                | 9     |
| 3        | <b>Design And Analysis Of Machine Learning Experiments:</b> Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm, and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test                                          | 8     |
| 4        | <b>Ensemble Techniques And Unsupervised Learning:</b> Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: Introduction to Clustering, K-means clustering, Dimensionality reduction-Principal Component Analysis                                                                                             | 8     |
| 5        | <b>Reinforcement Learning:</b> Introduction, Learning Task, Q Learning, Non-deterministic Rewards and actions, temporal-difference learning, Relationship to Dynamic Programming, Active reinforcement learning, Generalization in reinforcement learning                                                                                                                                       | 9     |

**Prescribed Text Books:**

| Sl. No. | Book Title                                                | Authors        | Edition         | Publisher | Year |
|---------|-----------------------------------------------------------|----------------|-----------------|-----------|------|
| 1       | Introduction to Machine Learning                          | Ethem Alpaydin | 4 <sup>th</sup> | MIT Press | 2020 |
| 2       | Hands-on Machine Learning with Scikit- Learn & TensorFlow | Aurelien Geron | 2 <sup>nd</sup> | O'Reilly  | 2019 |



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**Reference Text Books:**

| Sl. No. | Book Title                                   | Authors                                             | Edition         | Publisher        | Year |
|---------|----------------------------------------------|-----------------------------------------------------|-----------------|------------------|------|
| 1       | Pattern Recognition and Machine Learning     | Christopher M. Bishop                               | 1 <sup>st</sup> | Springer         | 2006 |
| 2       | Foundations of Machine Learning              | Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar | 2 <sup>nd</sup> | MIT Press        | 2018 |
| 3       | Python Machine Learning                      | Sebastain Raschka, Vahid Mirjalili                  | 3 <sup>rd</sup> | Packt Publishing | 2019 |
| 4       | Machine Learning                             | Tom Mitchell                                        | 3 <sup>rd</sup> | McGraw Hill      | 1997 |
| 5       | Machine Learning: An Algorithmic Perspective | Stephen Marsland                                    | 2 <sup>nd</sup> | CRC Press        | 2014 |

**E-Book:**

| Sl. No. | Book Title                                                | Authors                                | Edition         | Publisher                  | Year | URL                                                                                                                                                                                                                                                 |
|---------|-----------------------------------------------------------|----------------------------------------|-----------------|----------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Understanding Machine Learning: From Theory to Algorithms | Shai Shalev-Shwartz and Shai Ben-David | 1 <sup>st</sup> | Cambridge University Press | 2014 | <a href="https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf">https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf</a> |

**MOOC Course:**

| Sl. No. | Course name                      | Course Offered By | Year | URL                                                                                       |
|---------|----------------------------------|-------------------|------|-------------------------------------------------------------------------------------------|
| 1       | Introduction to Machine Learning | NPTEL             | 2023 | <a href="https://nptel.ac.in/courses/106106139">https://nptel.ac.in/courses/106106139</a> |

**Course Outcomes (COs):**

|            |                                                                             |
|------------|-----------------------------------------------------------------------------|
| <b>CO1</b> | Apply machine learning techniques in computing systems                      |
| <b>CO2</b> | Analyse the given machine learning model.                                   |
| <b>CO3</b> | Design a model using machine learning algorithms to solve a problem.        |
| <b>CO4</b> | Evaluate end-to-end machine learning pipelines for real-world applications. |



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### CO-PO-PSO mapping:

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     |     | 3   |     | 3   |     |     |     |     |      |      |      |      |      |
| CO4 |     |     |     | 2   |     | 2   |     | 2   | 2   |      |      |      |      | 2    |

### Assessment Plan for CIE:

| Tool                            | Remarks        | Marks |
|---------------------------------|----------------|-------|
| Internals                       | Best 2 of 3    | 20    |
| Quiz                            | -              | -     |
| Lab Component                   | CIE + Lab Test | 25    |
| Alternate Assessment Tool (AAT) | ONE            | 05    |
| Total                           |                | 50    |

### Laboratory Plan:

- Students should write the program (pseudocode) for that week to be executed in the lab at the beginning of each lab and get it corrected by the batch-in-charge faculty and then start with the program execution.
- Soft copy (PDF file) of all the programs along with the output needs to be submitted before the lab test.
- Continuous Internal Evaluation for each lab is for 10 marks which includes execution of the program in the allotted lab time and showing the output.

### Note:

- Student completes the program on the day within the lab timings and shows the output for any given input case: 10 marks
- Student completes the program on the day within the lab timings and shows the output for only some input cases: 8 marks
- Student completes the program on the day and shows the output for any given input case: 6 marks
- Student completes the program on the day within one week and shows the output for any given input case: 4 marks
- Submission any later: 0 marks

4. Open end lab test will be conducted. The scenario-based questions will be asked, the students should identify the appropriate dataset and implement the suitable machine learning model

5. Marks split up for Lab:

Continuous Internal Evaluation: **100 marks à reduced to 10 marks**

Lab Test: **50 marks → reduced to 15 marks** (Write-up- 10 marks, Execution- 20 marks, Modification asked in the program for execution – 10 marks, Viva- 10 marks)



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| Lab Program | Unit # | Marks for Continuous Evaluation | Program Details                                                                                                     |
|-------------|--------|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| 1           | --     | ---                             | Write a python program to import and export data using Pandas library functions                                     |
| 2           | 1      | 10                              | Demonstrate various data pre-processing techniques for a given dataset                                              |
| 3           | 2      | 10                              | Use an appropriate data set for building the decision tree (ID3) and apply this knowledge to classify a new sample. |
| 4           | 2      | 10                              | Implement Linear and Multi-Linear Regression algorithm using appropriate dataset                                    |
| 5           | 2      | 10                              | Build Logistic Regression Model for a given dataset                                                                 |
| 6           | 2      | 10                              | Build KNN Classification model for a given dataset.                                                                 |
| 7           | 2      | 10                              | Build Support vector machine model for a given dataset                                                              |
| 8           | 4      | 10                              | Implement Random forest ensemble method on a given dataset.                                                         |
| 9           | 4      | 10                              | Implement Boosting ensemble method on a given dataset.                                                              |
| 10          | 4      | 10                              | Build k-Means algorithm to cluster a set of data stored in a .CSV file.                                             |
| 11          | 4      | 10                              | Implement Dimensionality reduction using Principle Component Analysis (PCA) method.                                 |

Students work in groups to design a complete end-to-end machine learning framework—from problem formulation to specifically centered on a comparative study of multiple algorithms. The goal is to choose suitable models based on trade-offs between complexity and real-world deployability. Students will navigate the full lifecycle, including data engineering, evaluation strategy, and deployment architecture, while mapping their solution to Sustainable Development Goals (SDGs).



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#### Student Project group Plan of Activities:

Following are the activities week-wise to be carried out by students during project work

| Sl. No | Week            | Activity                                                                              | No. of hours for self-learning |
|--------|-----------------|---------------------------------------------------------------------------------------|--------------------------------|
| 1      | 1 <sup>st</sup> | Problem Formulation and Data Acquisition & Assumptions, Data Preprocessing Pipeline   | 4                              |
| 2      | 2 <sup>nd</sup> | Exploratory Data Analysis (EDA), Feature Engineering Design and Feature Justification | 4                              |
| 3      | 3 <sup>rd</sup> | Model Design Strategy, Training Strategy                                              | 4                              |
| 4      | 4 <sup>th</sup> | Evaluation Framework, Validation Strategy                                             | 4                              |
| 5      | 5 <sup>th</sup> | Deployment Design, Monitoring and Maintenance Strategy, SDG Mapping                   | 4                              |
| 6      | 6 <sup>th</sup> | Final Deliverables and Reporting                                                      | 12                             |

#### Rubrics used for AAT evaluation:

##### Evaluation Rubric (Total: 10 Marks)

| Criterion                                            | Marks | Good                                                                                                                                           | Average                                                                                    | Poor                                                  |
|------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------------------------|
| <b>1. Problem Formulation &amp; Data Strategy</b>    | 2     | Clearly defined ML problem (inputs, outputs, horizon, math formulation); realistic multi-source dataset with handling of noise/missing data(2) | Partially defined problem and/or basic dataset with limited real-world considerations(1.5) | Unclear problem or unrealistic/missing dataset(1)     |
| <b>2. Feature Engineering &amp; Representation</b>   | 2     | Strong features capturing temporal, spatial, and domain patterns; proper preprocessing, scaling, encoding(2)                                   | Basic features with limited justification(1.5)                                             | Poor or missing feature engineering(1)                |
| <b>3. Model Design &amp; Evaluation Strategy</b>     | 3     | Well-justified model; handles non-linearity, imbalance; robust evaluation with correct metrics and temporal validation(3)                      | Reasonable model/evaluation but lacks depth or misses key aspects(2)                       | Inappropriate or poorly explained model/evaluation(1) |
| <b>4. Deployment, Monitoring &amp; System Design</b> | 1     | Clear end-to-end architecture; includes data flow, latency, scalability, drift detection, retraining(1)                                        | Partial system design; limited clarity or monitoring(.75)                                  | Missing or impractical deployment design(0.5)         |
| <b>5. SDG Mapping &amp; Clarity</b>                  | 2     | Strong ethical analysis, fairness, SDG alignment; well-structured and justified(2)                                                             | Basic coverage with limited depth(1)                                                       | Missing or unclear(0.5)                               |



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|                      |                                     |                             |           |
|----------------------|-------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>6</b>                            |                             |           |
| <b>Course Title:</b> | <b>Research Methodology and IPR</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS6AERMI</b>                   | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                        | <b>Total Credits:</b>       | <b>3</b>  |

Research Methodology and IPR is offered as a MOOC / NPTEL course. Students are required to enroll in and complete the course offered on the NPTEL platform. The course details are listed below. The offering may vary based on its availability on the platform. In case the course is unavailable during the offering term, an equivalent alternative will be notified by the department.

| Sl. No. | NPTEL Code | Course Title                 | Link                                                                                                                                          |
|---------|------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | NOC26-GE79 | Research Methodology and IPR | <a href="https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge79">https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge79</a> |

**MOOC Course:**

| Sl. No. | Course name          | Course Offered By | Year | URL                                                                                                                                           |
|---------|----------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Research Methodology | NPTEL             | 2024 | <a href="https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge79">https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge79</a> |

**Course Outcomes (COs):**

|     |                                                                                                                                                                                                                                           |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Demonstrate the ability to plan, conduct, analyze, communicate, and ethically disseminate research by applying appropriate research methodologies, experimental and analytical skills, AI tools, creativity, and collaborative practices. |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**CO-PO-PSO Mapping:**

|             | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PS O1 | PS O2 | PS O3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| <b>CO 1</b> |      |      |      |      |      |      |      |      |      |       | 3     |       |       |       |



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**Assessment Plan for CIE and SEE:**

| Tool                            | Remarks                               | Marks |
|---------------------------------|---------------------------------------|-------|
| Internals                       | Weekly assessments<br>Via assignments | 25    |
| Quiz                            | -                                     | -     |
| Lab Component                   | --                                    | --    |
| Alternate Assessment Tool (AAT) | -                                     | -     |
| SEE                             | MCQs conducted by NPTEL               | 75    |
| Total                           |                                       | 100   |

**Guidelines:**

- Students are eligible to enroll in AICTE-approved 8/12-week NPTEL courses with proctored examinations.
- A student can enroll and complete the course during the 3rd year of study. However, he/she may claim only one NPTEL course per semester for credit transfer as per the scheme.
- A 8/12-week NPTEL course will be equivalent to 3 institute credits at the institute level.
- Students must obtain prior approval from the Department's NPTEL Course Coordinator and the Head of the Department.
- Strict monitoring of the student's progress in the registered NPTEL course will be done by the student's proctor, the Department's NPTEL Course Coordinator, and the Head of the Department.

**Assessment:**

Students must appear for the NPTEL proctored final examination, and the grades obtained will be mapped to the institute's grading system as follows:

| NPTEL Score | Institute Grade | Grade Point   |
|-------------|-----------------|---------------|
| 90 – 100    | O               | 10            |
| 80 – 89     | A+              | 9             |
| 70 – 79     | A               | 8             |
| 60 – 69     | B+              | 7             |
| 50 – 59     | B               | 6             |
| 45 – 49     | C               | 5             |
| 40 – 44     | D               | 4             |
| Below 40    | F (Fail)        | 0 (No Credit) |



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- If a student scores below 40%, the course shall be marked as F (Fail), and no credits will be transferred.
- The student must then take the NPTEL course in the next academic term as per institute academic policies.
- At the end of the 8th semester, if a student fails to clear the NPTEL course, a special provision may be provided as per the NPTEL supplementary exam guideline, which states that the CIE of NPTEL shall be considered and the SEE shall be conducted by the institution based on the NPTEL curriculum and assignments of the respective course

**NOTE:** The above course is to be taken up by students via NPTEL platform. The marks received from the NPTEL platform will be retained and is an equivalent to the corresponding course offered by the department/college.



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|                      |                                   |                             |           |
|----------------------|-----------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>6</b>                          |                             |           |
| <b>Course Title:</b> | <b>Advanced Computer Networks</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS6PEACN</b>                 | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                      | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                | <b>Hours</b> |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Overview of data communication model</b> – Internet Multicasting, VPN – Routing Algorithms – BGP, OSPF – Differentiated and Integrated Services – SONET, ATM – MPLS -Next generation Internet architectures, Green Communication Networks, and Data Center Networking                                     | <b>8</b>     |
| <b>2</b>        | <b>High Performance Switching:</b> Introduction, performance considerations, IP address lookup. Algorithms for IP address lookup and optimization, hardware implementation of address lookup                                                                                                                 | <b>8</b>     |
| <b>3</b>        | Analysis of Network congestion Mechanism, ARQ protocols Multimedia Networking; Implementation of multi-threaded Web Server/Web Proxy with Caching/Filtering features, Sliding Window protocol implementation, performance study of various TCP/IP variants                                                   | <b>9</b>     |
| <b>4</b>        | <b>Packet Classification:</b> Need for packet classification and methods for packet classification. Software Defined Networking (SDN) - Deep Dive (Northbound and Southbound interface), Working with Mininet. Network Function Virtualization (NFV) - Architecture and Concepts                             | <b>9</b>     |
| <b>5</b>        | <b>Software Defined Network</b> -Comparison between SDN and traditional networks - SDN controller, Switch design, SDN Controller-Switch Protocols, Open Flow Protocol, Control Overhead & Handoff algorithms. Network Function Virtualization -NFV Architecture, Use cases, NFV Orchestration and NFV for 5G | <b>8</b>     |

**Prescribed Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                                             | <b>Authors</b>                                        | <b>Edition</b>  | <b>Publisher</b>        | <b>Year</b> |
|----------------|---------------------------------------------------------------|-------------------------------------------------------|-----------------|-------------------------|-------------|
| 1              | Computer Networks                                             | Tanenbaum AS, Wetherall DJ                            | 5 <sup>th</sup> | Pearson Education       | 2011        |
| 2              | High Performance Switches and Routers                         | H. Jonathan Chao, Bin Liu                             | 1 <sup>st</sup> | John Wiley & Sons, Inc. | 2007        |
| 3              | Information-Centric Networks: A New Paradigm for the Internet | Gabriel M. de Brito, Pedro B. Velloso, Igor M. Moraes | 1 <sup>st</sup> | Wiley-ISTE              | 2013        |

**Reference Text Books:**

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| Sl. No. | Book Title                                                                                                           | Authors                                                                       | Edition         | Publisher                                        | Year |
|---------|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-----------------|--------------------------------------------------|------|
| 1       | Software-Defined Networks: A Systems Approach                                                                        | Larry Peterson, Carmelo Cascone, Brian O'Connor, Thomas Vachuska, Bruce Davie | 2 <sup>nd</sup> | Systems Approach LLC                             | 2021 |
| 2       | Information-Centric Networking (ICN): Content Centric Networking (CCNx) and Named Data Networking (NDN) Terminology. | B. Wissingh, C. Wood, A. Afanasyev, L. Zhang, D. Oran, C. Tschudin            | RFC 8793        | RFC Stream - Internet Research Task Force (IRTF) | 2020 |

**E-Books:**

| Sl. No. | Book Title                                                 | Authors                                               | Edition         | Publisher         | Year | URL                                                                                                                                                                                 |
|---------|------------------------------------------------------------|-------------------------------------------------------|-----------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Network Functions Virtualization (NFV) with a Touch of SDN | Rajendra Chayapathi, Syed Farrukh, Hassan Paresh Shah | 1 <sup>st</sup> | Pearson Education | 2017 | <a href="https://ptgmedia.pearsoncmg.com/images/9780134463056/samplepages/9780134463056.pdf">https://ptgmedia.pearsoncmg.com/images/9780134463056/samplepages/9780134463056.pdf</a> |
| 2       | Software Defined Networks, A Comprehensive Approach        | Paul Goransson, Chuck Black, Timothy Culver           | 2 <sup>nd</sup> | Elsevier Inc.     | 2017 | <a href="https://www.sciencedirect.com/book/9780128045558/software-defined-networks">https://www.sciencedirect.com/book/9780128045558/software-defined-networks</a>                 |



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**MOOC Courses:**

| Sl. No. | Course name                     | Course offered by | Year | URL                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------|---------------------------------|-------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Network Function Virtualization | Coursera          | 2024 | <a href="https://www.coursera.org/learn/network-virtual?irclickid=QZv0lCz8OxyNUfJ1ajTOLyNMUkC1AOR8Z2nYws0&amp;irgwc=1&amp;utm_medium=partners&amp;utm_source=impact&amp;utm_campaign=259799&amp;utm_content=b2c#modules">https://www.coursera.org/learn/network-virtual?irclickid=QZv0lCz8OxyNUfJ1ajTOLyNMUkC1AOR8Z2nYws0&amp;irgwc=1&amp;utm_medium=partners&amp;utm_source=impact&amp;utm_campaign=259799&amp;utm_content=b2c#modules</a> |
| 2       | Software Defined Networking     | Coursera          | 2024 | <a href="https://www.coursera.org/learn/sdn?irclickid=QZv0lCz8OxyNUfJ1ajTOLyNMUkC1AIQZ2nYws0&amp;irgwc=1&amp;utm_medium=partners&amp;utm_source=impact&amp;utm_campaign=259799&amp;utm_content=b2c#modules">https://www.coursera.org/learn/sdn?irclickid=QZv0lCz8OxyNUfJ1ajTOLyNMUkC1AIQZ2nYws0&amp;irgwc=1&amp;utm_medium=partners&amp;utm_source=impact&amp;utm_campaign=259799&amp;utm_content=b2c#modules</a>                           |

**Course Outcomes (COs):**

|            |                                                                                         |
|------------|-----------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the principles of high-performance networking devices                             |
| <b>CO2</b> | Analyze the various protocols and mechanisms in computer networks and SDN               |
| <b>CO3</b> | Design a network topology for a given scenario and demonstrate the performance analysis |

**CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5      | PO6 | PO7 | PO8 | PO9      | PO10     | PO11 | PSO1 | PSO2     | PSO3 |
|------------|----------|----------|----------|-----|----------|-----|-----|-----|----------|----------|------|------|----------|------|
| <b>CO1</b> | <b>3</b> |          |          |     |          |     |     |     |          |          |      |      |          |      |
| <b>CO2</b> |          | <b>2</b> |          |     |          |     |     |     |          |          |      |      |          |      |
| <b>CO3</b> |          |          | <b>3</b> |     | <b>3</b> |     |     |     | <b>2</b> | <b>2</b> |      |      | <b>2</b> |      |

**Assessment Plan for CIE:**

| Tool                                   | Remarks            | Marks     |
|----------------------------------------|--------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b> |
| <b>Quiz</b>                            | --                 | --        |
| <b>Lab Component</b>                   | --                 | --        |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>         | <b>10</b> |
| <b>Total</b>                           |                    | <b>50</b> |

**AAT Plan:**

Students are supposed to choose and explore any of the network simulators and demonstrate the topology designed for a scenario chosen. Students should explore the network parameters appropriate to the scenario designed and demonstrate the performance analysis done. A report has to be submitted in the prescribed format.



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| <b>Sl. No</b> | <b>Week</b>                                            | <b>Activity</b>                                                                               |
|---------------|--------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 1             | 1 <sup>st</sup> and 2 <sup>nd</sup>                    | Formation of groups. Note: Student groups of size 2 to 4 members only                         |
| 2             | 3 <sup>rd</sup>                                        | AAT topic selection by each group                                                             |
| 3             | 4 <sup>th</sup>                                        | Presentation: Student team and topic introduction by each group                               |
| 4             | 5 <sup>th</sup> , 6 <sup>th</sup> and 7 <sup>th</sup>  | Demonstration of the topology designed for a chosen scenario                                  |
| 5             | 8 <sup>th</sup> , 9 <sup>th</sup> and 10 <sup>th</sup> | Demonstration of the parameters considered for performance analysis of the topology designed. |
| 6             | 11 <sup>th</sup> and 12 <sup>th</sup>                  | AAT Report Preparation                                                                        |



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**Rubrics used for evaluation:**

| Criteria                                                               | Exemplary                                                                                                               | Proficient                                                                                                                   | Partially Proficient                                                                                                      | Points |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------|
| Selection of an appropriate Network simulator                          | (4-3)<br>The network simulator chosen supports the implementation of all the concepts for the chosen scenario.          | (2)<br>The network simulator chosen supports the implementation of most of the concepts for the chosen scenario.             | (1)<br>The network simulator chosen supports the implementation of few of the concepts for the chosen scenario.           | ___/4  |
| Selection of scenario for demonstration                                | (4-3)<br>The chosen scenario has an exceptional scenario.                                                               | (2)<br>The chosen scenario has an acceptable scenario.                                                                       | (1)<br>The chosen scenario has a simple scenario.                                                                         | ___/4  |
| Design and implement the scenario in the chosen simulator              | (8-6)<br>The topology design and implementation of the chosen scenario is done with all of the functionalities required | (5-3)<br>The topology design and implementation of the chosen scenario is done with most of the functionalities required.    | (2-1)<br>The topology design and implementation of the chosen scenario is done with some of the functionalities required. | ___/8  |
| Performance analysis of the designed topology for the chosen scenario. | (8-6)<br>Performance analysis is done for all the basic network parameters on the designed topology                     | (5-3)<br>Performance analysis is done for most of the basic network parameters on the designed topology                      | (2-1)<br>Performance analysis is done for some of the basic network parameters on the designed topology                   | ___/8  |
| Report                                                                 | (8-6)<br>Clear and effective writing and adherence to appropriate style guidelines                                      | (5-3)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines | (2-1)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines                 | ___/8  |



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|                                   |                                                                                 |                                                                          |                                                                         |        |
|-----------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------|--------|
| Oral communication (presentation) | (4-3)<br>Clear and effective communication                                      | (2)<br>Communication is clear                                            | (1-0)<br>Unclear communication                                          | ___/4  |
| Participation in Discussions      | (4-3)<br>Provided many good ideas; inspired others; clearly communicated Ideas. | (2)<br>Participated in discussions; on some occasions, made suggestions. | (1-0)<br>Listened mainly; Rarely spoke up, and ideas were off the mark. | ___/4  |
| <b>Total</b>                      |                                                                                 |                                                                          |                                                                         | ___/40 |



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|                      |                       |                             |    |
|----------------------|-----------------------|-----------------------------|----|
| <b>Semester:</b>     | 6                     |                             |    |
| <b>Course Title:</b> | Blockchain Technology |                             |    |
| <b>Course Code:</b>  | 23CS6PEBLC            | <b>Total Contact Hours:</b> | 42 |
| <b>L-T-P:</b>        | 3-0-0                 | <b>Total Credits:</b>       | 3  |

| Unit No. | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Hours |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1        | <p><b>Blockchain Essentials:</b> The history of Blockchain and Bitcoin, The Growth of Blockchain Technology, Blockchain- Definition, Architecture, Generic elements of a Blockchain, Benefits, Features and Limitations, Types of Blockchain, Consensus.</p> <p><b>Decentralization:</b> Decentralization using Blockchain, Decentralized Applications.</p> <p><b>Cryptographic Constructs in Blockchain:</b> Cryptographic primitives- Hash function, ECC Digital Signature, Zero Knowledge proof, Different types of digital signatures.</p> <p><b>Applications of Cryptographic Hash Functions:</b> Merkel Trees, Patricia Trees, Distributed Hash Table.</p> | 9     |
| 2        | <p><b>Consensus Algorithms:</b> Introducing the Consensus Problem, Analysis and Design, Classification, Algorithms, Choosing an Algorithm.</p> <p><b>Transactions:</b> Transaction Life Cycle, Genesis block, Mining.</p> <p><b>Bitcoin:</b> Overview, Cryptographic Keys, Bitcoin Network, Wallets, Bitcoin Payments, Innovation in Bitcoin, Alternative coins- Introduction, Theoretical Foundations- Alternative Proof of Work.</p>                                                                                                                                                                                                                           | 8     |
| 3        | <p><b>Ethereum:</b> An Overview, Ethereum Network, Components of Ethereum Ecosystem, Ethereum Virtual Machines</p> <p><b>Smart Contracts:</b> History, Definition, Deploying Smart Contracts.</p> <p><b>Solidity:</b> Variables, Data types, Control Structures, Events, Inheritance, Libraries, Functions, Error Handling.</p> <p><b>Smart Contract Security:</b> Reentrancy, Arithmetic Over/Underflows</p>                                                                                                                                                                                                                                                    | 9     |
| 4        | <p><b>Decentralized Applications (DApps):</b> What Is a DApp, A Basic DApp Example, Further Decentralizing the Auction DApp, Storing the Auction DApp on Swarm, The Ethereum Name Service (ENS), From App to DApp.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8     |
| 5        | <p><b>Hyperledger:</b> Architecture, Projects under Hyperledger, Hyperledger Fabric, Hyperledger Sawtooth.</p> <p><b>Tokenization:</b> Tokenization on a blockchain, Types of tokens, Process of Tokenization, Token offerings</p>                                                                                                                                                                                                                                                                                                                                                                                                                               | 8     |



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**Prescribed Text Books:**

| Sl. No. | Book Title                                             | Authors                                 | Edition         | Publisher | Year |
|---------|--------------------------------------------------------|-----------------------------------------|-----------------|-----------|------|
| 1       | Mastering Blockchain                                   | Imran Bashir                            | 3 <sup>rd</sup> | Packt     | 2020 |
| 2       | Mastering Ethereum: Building Smart Contracts and DApps | Andreas M. Antonopoulos, Dr. Gavin Wood | 1 <sup>st</sup> | O'Reilly  | 2018 |

**Reference Text Book:**

| Sl. No. | Book Title                      | Authors     | Edition         | Publisher | Year |
|---------|---------------------------------|-------------|-----------------|-----------|------|
| 1       | Solidity Programming Essentials | Ritesh Modi | 1 <sup>st</sup> | Packt     | 2018 |

**E-Book:**

| Sl. No. | Book Title                                             | Authors                                 | Edition         | Publisher | Year | URL                                                                                                     |
|---------|--------------------------------------------------------|-----------------------------------------|-----------------|-----------|------|---------------------------------------------------------------------------------------------------------|
| 1       | Mastering Ethereum: Building Smart Contracts and DApps | Andreas M. Antonopoulos, Dr. Gavin Wood | 1 <sup>st</sup> | O'Reilly  | 2018 | <a href="https://github.com/ethereumbook/ethereumbook">https://github.com/ethereumbook/ethereumbook</a> |

**MOOC Courses:**

| Sl. No. | Course Name                                                                                                                                                     | Course Offered by | URL                                                                                                                   |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------|
| 1       | Blockchain Specialization<br>Course 1: Blockchain Basics<br>Course 2: Smart contracts<br>Course 3: Decentralized Applications<br>Course 4: Blockchain Platforms | Coursera          | <a href="https://www.coursera.org/specializations/blockchain">https://www.coursera.org/specializations/blockchain</a> |
| 2       | Blockchain Architecture, Design and Use cases                                                                                                                   | NPTEL             | <a href="https://nptel.ac.in/courses/106/105/106105184/">https://nptel.ac.in/courses/106/105/106105184/</a>           |

**Course Outcomes (COs):**

|            |                                                                               |
|------------|-------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the principles of Blockchain and Cryptocurrency for a given application |
| <b>CO2</b> | Analyze the various protocols and mining techniques in Blockchain             |
| <b>CO3</b> | Design Blockchain based solution for a given scenario                         |



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**CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5 | PO6 | PO7 | PO8      | PO9      | PO 10 | PO11 | PSO1 | PSO2     | PSO3 |
|------------|----------|----------|----------|-----|-----|-----|-----|----------|----------|-------|------|------|----------|------|
| <b>CO1</b> | <b>3</b> |          |          |     |     |     |     |          |          |       |      |      |          |      |
| <b>CO2</b> |          | <b>3</b> |          |     |     |     |     |          |          |       |      |      |          |      |
| <b>CO3</b> |          |          | <b>2</b> |     |     |     |     | <b>2</b> | <b>2</b> |       |      |      | <b>2</b> |      |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>           | <b>Marks</b> |
|----------------------------------------|--------------------------|--------------|
| <b>Internals</b>                       | <b>Best 2 of 3 Tests</b> | <b>40</b>    |
| <b>Quiz</b>                            | --                       | --           |
| <b>Lab Component</b>                   | --                       | --           |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>               | <b>10</b>    |
| <b>Total</b>                           |                          | <b>50</b>    |

**AAT Plan:**

Students need to develop and demonstrate DApps. Team size of 3 to 4 students. A report has to be submitted in the prescribed format.

| <b>Sl. No</b> | <b>Week</b>       | <b>Activity</b>                                                       |
|---------------|-------------------|-----------------------------------------------------------------------|
| 1             | 1st and 2nd       | Formation of groups. Note: Student groups of 3-4 members.             |
| 2             | 3rd               | AAT topic selection by each group.                                    |
| 3             | 4th               | Presentation: Student team and topic introduction by each group.      |
| 4             | 5th, 6th and 7th  | Identifying and exploring the tools required for development of DApps |
| 5             | 8th, 9th and 10th | Implementation and report preparation.                                |
| 6             | 11th and 12th     | Demonstration and report submission.                                  |



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Rubrics used for AAT evaluation:

| Criteria                              | Exemplary                                                                                                                      | Proficient                                                                                                                     | Partially Proficient                                                                                      | Points |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|--------|
| Design and Implementation of the DApp | (18-12)<br>Design and Implementation of the application using appropriate features for all set objectives showcasing teamwork. | (11-7)<br>Design and Implementation of modules using appropriate features for most of the set objectives, showcasing teamwork. | (6-0) Some of the modules are not implemented in accordance with the design with minimal teamwork.        | ___/18 |
| Demonstration of DApp                 | (10-7)<br>Demonstrates the functionality of the application using appropriate reports or plots for various cases.              | (6-3)<br>Demonstrates the functionality of the application using appropriate reports or plots for few cases.                   | (2-0)<br>Demonstrates the functionality of the application without much reporting.                        | ___/10 |
| Oral communication. (presentation)    | (5-4)<br>Clear and effective communication. Answered all the questions                                                         | (3-2)<br>Communication is clear. Answered most of the questions                                                                | (1-0)<br>Unclear communication Answered only few of the questions                                         | ___/5  |
| Report                                | (7-5)<br>Clear and Effective writing and adherence to appropriate style guidelines                                             | (4-3)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines   | (2-0)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines | ___/7  |
| Total                                 |                                                                                                                                |                                                                                                                                |                                                                                                           | ___/40 |

Note: Note: AAT will be evaluated for 40 marks and reduced to 10 marks.



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|                      |                                             |                             |           |
|----------------------|---------------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>6</b>                                    |                             |           |
| <b>Course Title:</b> | <b>Computer Vision and Image Processing</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS6PECVI</b>                           | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                                | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Hours</b> |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Introduction:</b> Image representation, Image digitization, Digital image properties, Color images.<br><br><b>Image pre-processing:</b> Pixel brightness transformations, Geometric transformations, local pre-processing.                                                                                                                                                                                                                                                                                                                                                                                        | <b>8</b>     |
| <b>2</b>        | <b>Segmentation:</b> Thresholding, Edge- based segmentation, Region based segmentation, Matching.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>8</b>     |
| <b>3</b>        | <b>Image understanding:</b> Image understanding control strategies, SIFT, RANSAC, Point distribution models, Active appearance models, Pattern recognition methods in image understanding, Boosted cascade of classifiers, Image understanding using random forests , Scene labelling and constraint propagation, Semantic image segmentation and understanding, Hidden Markov models, Gaussian mixture models and expectation maximization, Basics of projective geometry, A single perspective camera, Scene reconstruction from multiple views.                                                                   | <b>9</b>     |
| <b>4</b>        | <b>Image data compression and motion analysis:</b> Image data properties, Discrete image transforms in image data compression, Predictive compression methods, Vector quantization, Hierarchical and progressive compression methods, Comparison of compression methods, JPEG and MPEG image compression, Statistical Texture description, Syntactic texture description methods, Hybrid texture description methods, Differential motion analysis methods, Optical Flow, Analysis based on correspondence of interest points, Detection of specific motion patterns, video tracking, motion models to aid tracking. | <b>9</b>     |
| <b>5</b>        | <b>Shape representation and morphology:</b> Region identification, Contour-based shape representation and description, Region based shape representation and description, Shape classes, Morphology concepts and principles, Binary dilation and erosion, Gray- scale dilation and erosion, Skeletons and object marking, Granulometry, Morphology segmentation and watersheds.                                                                                                                                                                                                                                      | <b>8</b>     |



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**Prescribed Text Book:**

| Sl. No. | Book Title                                    | Authors                                 | Edition         | Publisher        | Year |
|---------|-----------------------------------------------|-----------------------------------------|-----------------|------------------|------|
| 1       | Image Processing, Analysis and Machine Vision | Milan Sonka, Vaclav Hlavac, Roger Boyle | 4 <sup>th</sup> | Cengage Learning | 2013 |

**Reference Text Books:**

| Sl. No. | Book Title                          | Authors                              | Edition         | Publisher         | Year |
|---------|-------------------------------------|--------------------------------------|-----------------|-------------------|------|
| 1       | Computer Vision – A Modern Approach | Forsyth, Ponce                       | 2 <sup>nd</sup> | Prentice Hall     | 2011 |
| 2       | Digital Image Processing            | Rafael C. Gonzalez, Richard E. Woods | 3 <sup>rd</sup> | Pearson Education | 2009 |

**E book:**

| Sl. No | Book Title                        | Authors     | Edition         | Year | Link                                                              |
|--------|-----------------------------------|-------------|-----------------|------|-------------------------------------------------------------------|
| 1      | Introduction to Computer Graphics | David J Eck | 1 <sup>st</sup> | 2022 | <a href="https://szeliski.org/Book">https://szeliski.org/Book</a> |

**MOOC Courses:**

| Sl. No. | Course name                                               | Course offered by | Year | URL                                                                                                                                                                                     |
|---------|-----------------------------------------------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Image Processing and Computer Vision with Python & OpenCV | Udemy             | 2023 | <a href="https://www.udemy.com/course/image-processing-and-computer-vision-with-python-opencv">https://www.udemy.com/course/image-processing-and-computer-vision-with-python-opencv</a> |
| 2       | Computer Vision and image processing fundamentals         | NPTEL             | 2023 | <a href="https://archive.nptel.ac.in/courses/108/103/108103174/">https://archive.nptel.ac.in/courses/108/103/108103174/</a>                                                             |

**Course Outcomes (COs):**

|            |                                                                           |
|------------|---------------------------------------------------------------------------|
| <b>CO1</b> | Apply suitable techniques to process and analyse images.                  |
| <b>CO2</b> | Analyse appropriate operations for a given scenario.                      |
| <b>CO3</b> | Implement various segmentation, compression and morphological algorithms. |

**CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5      | PO6 | PO7 | PO8 | PO9      | PO10     | PO11 | PSO1 | PSO2 | PSO3 |
|------------|----------|----------|----------|-----|----------|-----|-----|-----|----------|----------|------|------|------|------|
| <b>CO1</b> | <b>3</b> |          |          |     |          |     |     |     |          |          |      |      |      |      |
| <b>CO2</b> |          | <b>3</b> |          |     |          |     |     |     |          |          |      |      |      |      |
| <b>CO3</b> |          |          | <b>3</b> |     | <b>2</b> |     |     |     | <b>2</b> | <b>2</b> |      |      |      |      |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Assessment Plan for CIE:**

| Tool                                   | Remarks                | Marks     |
|----------------------------------------|------------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 out of 3</b> | <b>40</b> |
| <b>Quiz</b>                            | -                      | -         |
| <b>Lab Component</b>                   | -                      | -         |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>             | <b>10</b> |
| <b>Total</b>                           |                        | <b>50</b> |

**AAT Plan**

Students have to develop a simple application using Open CV. They are required to present their application and also submit a concluding report

**Rubrics used for AAT evaluation:**

| Criteria                       | Very Good                                                                             | Good                                                                            | Fair                                                                                | Poor                                                                     | Points  |
|--------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------|
| Problem Formulation            | (8-6)<br>The depth of the problem is exceptionally formulated.                        | (5-3)<br>The depth of problem is formulated to a sufficient level.              | (2)<br>The depth of the problem is weakly formulated.                               | (1)<br>The problem is not well formulated.                               | ___ / 8 |
| Implementation                 | (12-10)<br>The design and implementation is complete and fully correct                | (9-7)<br>The design and implementation is almost complete and correct.          | (6-3)<br>The design and implementation is partially complete and partially correct. | (2-1)<br>The design and implementation is not complete and is incorrect. | ___/12  |
| Output                         | (10-8)<br>Executes without errors. Thorough and organized testing has been completed. | (7-6)<br>Executes without errors. Testing has been completed on few test cases. | (5-3)<br>Executes with minor errors. Testing has been completed on few test cases.  | (2-1)<br>No execution and has errors.                                    | ___/10  |
| Documentation and presentation | (10-8)<br>Report is as per specified format and complete. Presentation is             | (7-5)<br>Report is complete and contents are not as per format.                 | (4-2)<br>Report is incomplete and contents are not as per format.                   | (1)<br>Report is incomplete, incorrect and does                          | ___/10  |



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|       |                        |                        |                           |                                                              |                     |
|-------|------------------------|------------------------|---------------------------|--------------------------------------------------------------|---------------------|
|       | clear and exceptional. | Presentation is clear. | Presentation is moderate. | not comply to the format specified. Presentation is unclear. |                     |
| Total |                        |                        |                           |                                                              | <u>    </u> /4<br>0 |

**Note:** The AAT will be evaluated for 40 marks and reduced to 10 marks



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|                      |                          |                             |    |
|----------------------|--------------------------|-----------------------------|----|
| <b>Semester:</b>     | 6                        |                             |    |
| <b>Course Title:</b> | Advanced Data Structures |                             |    |
| <b>Course Code:</b>  | 23CS6PEADS               | <b>Total Contact Hours:</b> | 42 |
| <b>L-T-P:</b>        | 3-0-0                    | <b>Total Credits:</b>       | 3  |

| Unit No | Topics                                                                                                                                                                                                                                                                                             | Hours |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1       | <b>Disjoint Sets:</b> Basic Data Structure, Smart Union algorithms, Path Compression, Time Complexity for Union-by-Rank, Applications.<br><b>Advanced Lists:</b> Generic Linked List, Memory efficient doubly linked list – XOR Linked List, Skip List, Self-Organizing List, Unrolled LinkedList. | 8     |
| 2       | <b>Self-Balancing Trees:</b> AVL Trees–Construction, Insertion, Rotation, Deletion, 2-3 Trees–Construction, Insertion and Deletion, B-Trees–Construction, Insertion and Deletion, Red-Black Trees–Construction, Insertion and Deletion, Splay Trees, Scape Goat Tree.                              | 9     |
| 3       | <b>Advanced Trees:</b> Trie–Insert, Search, Delete, Segment Tree–Construction, Range Minimum Query, Suffix Array and Suffix Tree–Construction, Substring Check, Binary Indexed Tree or Fenwick Tree - Construction, K Dimensional Tree–Construction.                                               | 9     |
| 4       | <b>Heaps:</b> Binomial Trees and Binomial Heaps–Operations on Binomial Heaps. Fibonacci Heaps - Operations on Fibonacci heaps, Skew heaps, Pairing heaps.                                                                                                                                          | 8     |
| 5       | <b>Priority Queues:</b> Model, Simple implementation, Binary Heap: structure property, heap-order property, other operations, d-heaps, Leftlist heaps: property, operations, skew heaps.<br><b>Advanced Hashing:</b> Perfect Hashing, Cuckoo Hashing, Hopscotch Hashing, Universal Hashing.        | 8     |

**Prescribed Text Books:**

| Sl. No. | Book Title                                    | Authors                                          | Edition         | Publisher         | Year |
|---------|-----------------------------------------------|--------------------------------------------------|-----------------|-------------------|------|
| 1       | Introduction to Algorithms                    | T. H Cormen,<br>C. E. Leiserson,<br>R. L. Rivest | 4 <sup>th</sup> | MIT Press         | 2022 |
| 2       | Data Structures and Algorithm Analysis in C++ | Marks Allen Wesis                                | 4 <sup>th</sup> | Pearson Education | 2013 |



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**Reference Text Book:**

| Sl. No. | Book Title                          | Authors                                           | Edition         | Publisher              | Year |
|---------|-------------------------------------|---------------------------------------------------|-----------------|------------------------|------|
| 1       | Fundamentals of Computer Algorithms | Ellis Horowitz,<br>Satraj Sahni,<br>Rajase kharam | 2 <sup>nd</sup> | Computer Science Press | 2009 |

**E-Book:**

| Sl. No. | Book Title                                    | Authors     | Edition         | Publisher         | Year | URL                                                                                                                                                                                                                         |
|---------|-----------------------------------------------|-------------|-----------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Data Structures and Algorithm Analysis in C++ | Allen Weiss | 4 <sup>th</sup> | Pearson Education | 2013 | <a href="https://www.uoitc.edu.iq/images/documents/informatics-institute/Competitive%20exam/DataStructures.pdf">https://www.uoitc.edu.iq/images/documents/informatics-institute / Competitive exam / DataStructures.pdf</a> |

**MOOC Courses:**

| Sl. No | Course name                     | Course Offered By | Year | URL                                                                                                          |
|--------|---------------------------------|-------------------|------|--------------------------------------------------------------------------------------------------------------|
| 1      | Data Structures and Algorithms  | NPTEL             | 2009 | <a href="https://nptel.ac.in/courses/106/102/106102064/">https://nptel.ac.in/courses/106 /102/106102064/</a> |
| 2      | Programming and Data Structures | NPTEL             | 2009 | <a href="https://nptel.ac.in/courses/106/105085/">https://nptel.ac.in/courses/106 105085/</a>                |

**Course Outcomes (COs):**

|            |                                                                          |
|------------|--------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concepts of advanced data structures for the given scenario    |
| <b>CO2</b> | Analyze the usage of appropriate data structure for a given application  |
| <b>CO3</b> | Develop solutions for a given scenario using appropriate data structures |

**CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5 | PO6 | PO7 | PO8      | PO9      | PO10 | PO11 | PSO1 | PSO2 | PSO3     |
|------------|----------|----------|----------|-----|-----|-----|-----|----------|----------|------|------|------|------|----------|
| <b>CO1</b> | <b>3</b> |          |          |     |     |     |     |          |          |      |      |      |      |          |
| <b>CO2</b> |          | <b>3</b> |          |     |     |     |     |          |          |      |      |      |      |          |
| <b>CO3</b> |          |          | <b>3</b> |     |     |     |     | <b>2</b> | <b>2</b> |      |      |      |      | <b>2</b> |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Assessment Plan for CIE:**

| Tool                                   | Remarks            | Marks     |
|----------------------------------------|--------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b> |
| <b>Quiz</b>                            | -                  | -         |
| <b>Lab Component</b>                   | -                  | -         |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>         | <b>10</b> |
| <b>Total</b>                           |                    | <b>50</b> |

**AAT Plan:**

The students have to go through the recent works on Advanced data structure concepts by referring high impact factor Journal articles and Identification of a problem which is feasible and develop innovative idea based on the current work.

Student Project group Plan of Activities:

Following are the activities week-wise to be carried out by students during project work

| Sl. No | Week              | Activity                                                             |
|--------|-------------------|----------------------------------------------------------------------|
| 1      | 1st               | Formation of groups. Note: Student groups of size 3 to 4 members.    |
| 2      | 2nd and 3rd       | Referring Journal articles and Identification of a problem statement |
| 3      | 4th               | Presentation of selected problem statement by each group             |
| 4      | 5th, 6th and 7th  | Implementation of defined problem statement                          |
| 5      | 8th, 9th and 10th | Demonstration of the developed code with results                     |
| 6      | 11th and 12th     | AAT report preparation                                               |

**Rubrics used for AAT evaluation:**

| Criteria                                                                                                       | Exemplary                                                                                                   | Proficient                                                                                                        | Partially Proficient                                                                      | Points |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------|
| Referring high impact factor Journal articles and Identification of innovative idea based on the current work. | (8-6) Referred high impact factor Journal articles and identified innovative idea based on the current work | (5-3) Referred few high impacts factor Journal articles and identified innovative idea based on the current work. | (2-0) Referred Journal articles and identified innovative idea based on the current work. | ___/8  |
| Implementation of the problem statement.                                                                       | (14-10) Implementation of the problem statement has been done accurately showcasing                         | (9-6) Implementation of the algorithm has been done appropriately showcasing integrity,                           | (5-0) Implementation of the algorithm has been done.                                      | ___/14 |



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|                            |                                                                                                                                                      |                                                                                                                                                                                      |                                                                                                                                                |        |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------|
|                            | efficiency, integrity, teamwork, scalability, sustainability and technical excellence.                                                               | teamwork and technical excellence.                                                                                                                                                   |                                                                                                                                                |        |
| Testing for various cases. | (6-5) The implemented algorithm works for any given valid input                                                                                      | (4-3) The implemented algorithm works for almost all valid inputs.                                                                                                                   | (2-0) The implemented algorithm works for some valid inputs.                                                                                   | ___/6  |
| Presentation and Report.   | (12-10) Clear and effective writing and adherence to appropriate style guidelines, effective communication and full participation in the discussion. | (9-6) Clear and effective writing for the most part with minor errors in adherence to appropriate style guidelines, clear communication and partial participation in the discussion. | (5-0) Unclear and ineffective writing in adherence to appropriate style guidelines, unclear communication, no participation in the discussion. | ___/12 |
| Total                      |                                                                                                                                                      |                                                                                                                                                                                      |                                                                                                                                                | ___/40 |

**Note: AAT will be evaluated for 40 marks and reduced to 10 marks.**



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|                      |                        |                             |           |
|----------------------|------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>6</b>               |                             |           |
| <b>Course Title:</b> | <b>Cloud Computing</b> |                             |           |
| <b>Course Code:</b>  | <b>25MC6OECS1</b>      | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>           | <b>Total Credits:</b>       | <b>3</b>  |

The Open Elective from the Department of Computer Science and Engineering is offered as a MOOC / NPTEL course. The course offered is listed below. In case the below subject is unavailable during the offering term, an equivalent alternative will be notified by the department.

| <b>Sl. No.</b> | <b>NPTEL Code</b> | <b>Course Title</b> | <b>Links</b>                                                                                                                                    |
|----------------|-------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>       | noc26_cs150       | Cloud Computing     | <a href="https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs150">https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs150</a> |

**COURSE OUTLINE:**

**Week 1 :** Introduction to Cloud Computing  
**Week 2 :** Cloud Computing Architecture  
**Week 3 :** Service Management in Cloud Computing  
**Week 4 :** Data Management in Cloud Computing  
**Week 5 :** Resource Management in Cloud  
**Week 6 :** Cloud Security  
**Week 7 :** Open Source and Commercial Clouds, Cloud Simulator  
**Week 8 :** Research trend in Cloud Computing, Fog Computing  
**Week 9 :** VM Resource Allocation, Management and Monitoring  
**Week 10 :** Cloud-Fog-Edge enabled Analytics  
**Week 11 :** Serverless Computing and FaaS Model  
**Week 12 :** Case Studies and Recent Advancements

**Course Outcomes (COs):**

|            |                                                                                                                                                                                                                                                                                                |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Explain the fundamentals of cloud computing including its architecture, service and data management, resource management, and security, and analyze open-source, commercial, and emerging cloud paradigms such as fog, edge, and serverless computing through relevant tools and case studies. |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



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**CO-PO-PSO Mapping:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CO 1 |      |      |      |      |      |      |      |      |      |       | 3     |       |       |       |

**Assessment Plan for CIE and SEE:**

| Tool                            | Remarks                               | Marks      |
|---------------------------------|---------------------------------------|------------|
| Internals                       | Weekly assessments<br>Via assignments | 25         |
| Quiz                            | -                                     | -          |
| Lab Component                   | --                                    | --         |
| Alternate Assessment Tool (AAT) | -                                     | -          |
| SEE                             | MCQs conducted by NPTEL               | 75         |
| <b>Total</b>                    |                                       | <b>100</b> |

**Guidelines:**

- Students are eligible to enroll in AICTE-approved 8/12-week NPTEL courses with proctored examinations.
- A student can enroll and complete the course during the 3rd year of study. However, he/she may claim only one NPTEL course per semester for credit transfer as per the scheme.
- A 8/12-week NPTEL course will be equivalent to 3 institute credits at the institute level.
- Students must obtain prior approval from the Department's NPTEL Course Coordinator and the Head of the Department.
- Strict monitoring of the student's progress in the registered NPTEL course will be done by the student's proctor, the Department's NPTEL Course Coordinator, and the Head of the Department.



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**Assessment:**

Students must appear for the NPTEL proctored final examination, and the grades obtained will be mapped to the institute's grading system as follows:

| NPTEL Score | Institute Grade | Grade Point   |
|-------------|-----------------|---------------|
| 90 – 100    | O               | 10            |
| 80 – 89     | A+              | 9             |
| 70 – 79     | A               | 8             |
| 60 – 69     | B+              | 7             |
| 50 – 59     | B               | 6             |
| 45 – 49     | C               | 5             |
| 40 – 44     | D               | 4             |
| Below 40    | F (Fail)        | 0 (No Credit) |

- If a student scores below 40%, the course shall be marked as F (Fail), and no credits will be transferred.
- The student must then take the NPTEL course in the next academic term as per institute academic policies.
- At the end of the 8th semester, if a student fails to clear the NPTEL course, a special provision may be provided as per the NPTEL supplementary exam guideline, which states that the CIE of NPTEL shall be considered and the SEE shall be conducted by the institution based on the NPTEL curriculum and assignments of the respective course.

**NOTE:** The above course is to be taken up by students via NPTEL platform. The marks received from the NPTEL platform will be retained and is an equivalent to the corresponding course offered by the department/college.



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|                      |                       |                       |   |
|----------------------|-----------------------|-----------------------|---|
| <b>Semester:</b>     | 6                     |                       |   |
| <b>Course Title:</b> | Major Project Phase-1 |                       |   |
| <b>Course Code:</b>  | 23CS6PWPP1            |                       |   |
| <b>L-T-P:</b>        | 0-0-2                 | <b>Total Credits:</b> | 2 |

**Guidelines:**

1. Students should form teams to carry out the project. The size of the teams can comprise of a minimum of three students and maximum of four students.
2. Teams are free to choose their Internal Guide or will be assigned an Internal Guide by the Department Coordinator.
3. Teams can carry out their project in-house or in a reputed organization (which has to be approved by the Internal Guide). Students taking up industry projects can do so with the condition that they are allowed to demonstrate their project work on the college campus.
4. Identification of a problem which is feasible and innovative based on the current state of art technology and having relevance and social impact, considering the boundaries of societal, environmental and ethical issues.
5. The project should address any one or more than one of the Seventeen Sustainable Development Goals (SDG) given by United Nations. The project should belong to the category of either "Community Oriented Project" or "Multidisciplinary Project" or both.
6. Survey of literature related to the identified problem to make a feasibility study and identify the project requirements. Prepare and submit a synopsis of your project to your respective Guides.
7. Based on the literature review, preparation of review paper and publishing it.
8. Evolve a high-level design/system level architecture and identify the various implementable modules with their input/output needs.
9. Preparation and submission of Project Phase1 technical report.
  - In-house project teams should meet their Guides weekly and update about the progress of the projects, whereas the industry project students should meet their Guides once in fifteen days.
  - CIE evaluation: Carried out twice in a semester by an internal panel comprising of Internal Guide and at least three other faculty members of the department.
  - SEE evaluation: Conducted at the end of the sixth semester by both internal guide and an external examiner from other institutions. Evaluation is based on the team presentation, project report and publication.

**Note:** CIE and SEE will be evaluated for 100 Marks and will be reduced to 50 Marks.



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### **Course Outcomes (COs):**

|            |                                                                                                                                                                                                                                |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the software engineering principles in planning, formulating an innovative design/ approach and computing the requirements appropriate to chosen topic within the context of legal, societal and environment constraint. |
| <b>CO2</b> | Apply the concepts of mathematics, science and engineering to implement the project and draw conclusions out of the results, while exhibiting integrity and ethical behaviour in engineering practice.                         |
| <b>CO3</b> | Monitor, manage project schedules, resources and work assignments to ensure timely completion.                                                                                                                                 |
| <b>CO4</b> | Test and defend performance of the implemented project and understand the implication of the solution.                                                                                                                         |
| <b>CO5</b> | Perform individually as well as in a team, accepting responsibility, taking initiative, and providing leadership, necessary to ensure project success.                                                                         |
| <b>CO6</b> | Use formal and informal communications with team members and guide, make presentations and prepare technical document.                                                                                                         |

### **CO-PO-PSO Mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> |     | 2   | 2   |     |     | 2   | 2   |     |     |      | 2    | 2    |      |      |
| <b>CO2</b> | 3   |     |     | 3   | 3   |     |     | 3   |     |      |      |      | 3    | 3    |
| <b>CO3</b> |     |     |     |     |     |     |     |     |     |      | 3    |      |      |      |
| <b>CO4</b> |     |     |     |     |     |     | 2   |     |     |      |      | 1    |      |      |
| <b>CO5</b> |     |     |     |     |     |     |     | 2   |     | 2    |      |      |      |      |
| <b>CO6</b> |     |     |     |     |     |     |     |     | 2   |      |      |      |      |      |

### **Assessment Plan for CIE:**

| <b>Tool</b>                | <b>Remarks</b> | <b>Marks</b> |
|----------------------------|----------------|--------------|
| <b>Evaluation by Guide</b> | --             | <b>48</b>    |
| <b>Evaluation by Panel</b> | --             | <b>50</b>    |
| <b>Peer Evaluation</b>     | --             | <b>2</b>     |
| <b>Total</b>               |                | <b>100</b>   |



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## **DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

### **Rubrics for Project Evaluation:**

| Criteria            | Exemplary                                                                                                                                                                                                                                              | Proficient                                                                                                                                                                                                                 | Partially Proficient                                                                                                                                                                                                              | Points |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Problem Formulation | (15)<br>Proposed an engineering problem that is relevant to current scenario, innovative, sustainable and practically achievable. Justification for the choice of problem selected. Has identified the functional and non-functional requirement       | (14-6)<br>Proposed an engineering problem that is relevant to current scenario and practically achievable. Justification for the choice of problem selected. Has identified the functional and non-functional requirement. | (5-1)<br>Proposed a fair engineering problem and practically achievable. Justification for the choice of problem selected. Has identified the functional and non-functional requirement.                                          | ___/15 |
| Planning            | (15)<br>Project schedule: Progress, milestones and deliverables with realistic estimates of the time (Gant chart). Identify resources: (hardware and software) required to accomplish the development effort. Cost estimates of hardware and software. | (14-6)<br>Project schedule: Progress, milestones and deliverables (Gant chart). Identify resources: (hardware and software) required to accomplish the development effort. Cost estimates of hardware and software.        | (5-1)<br>Project schedule: Progress, milestones and deliverables are not planned accordingly. Identify resources: (hardware and software) required to accomplish the development effort. Cost estimates of hardware and software. | ___/15 |
| Literature Survey   | (25)<br>Exhaustive/substantial Literature Survey done. Reviewed credible/quality literatures. Clearly summarized the ideas of sources by a thorough review of academic literature. Publication of Literature Review paper.                             | (24-15)<br>Reviewed credible/quality literatures. Clearly summarized the ideas of sources by a thorough review of academic literature. Publication of Literature Review paper.                                             | (14-1)<br>Reviewed few literatures. Fair summarization of the ideas of sources. Publication of Literature Review paper not done.                                                                                                  | ___/25 |



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|                    |                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                    |        |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| High Level Design  | (15)<br>Design is as per problem formulation.<br>Architectural design/<br>System design: Identifying the sub-systems. Abstract specification of the sub-systems, Interface design. Carefully chosen a methodology or approach that is well-suited to the formulated problem. | (14-6)<br>Design is as per problem formulation.<br>Architectural design/<br>System design: Identifying the sub-systems. Abstract specification of the sub-systems, Interface design.                                                                                                              | (5-1)<br>Design does not target the problem formulation optimally.<br>Architectural design/<br>System design: Identifying the sub-systems. Abstract specification of the sub-systems, Interface design.                                                                            | ___/15 |
| Report             | (10)<br>Clear and Effective writing and adherence to appropriate report format. All figures, graphs, charts, and drawings are accurate, consistent with the text, and of good quality. They enhance understanding of the text. All are labelled correctly.                   | (9-6)<br>Writing that is clear and effective for most part and minor errors in adherence to appropriate report format. All figures, graphs, charts, and drawings are accurate, consistent with the text, and of good quality. They enhance understanding of the text. All are labelled correctly. | (5-1)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate report format. All figures, graphs, charts, and drawings are accurate, consistent with the text, and of good quality. They enhance understanding of the text. All are labelled correctly. | ___/10 |
| Oral communication | (10)<br>Clear and effective communication. Presentation includes appropriate contents and is clearly organized. Presentation highlights key ideas and closes with a strong conclusion. Answer questions/queries professionally.                                              | (9-6)<br>Communication is clear. Presentation includes appropriate contents and is clearly organized. Presentation highlights key ideas. Answer questions/queries professionally.                                                                                                                 | (5-1)<br>Unclear communication. Presentation includes appropriate contents. Presentation highlights key ideas.                                                                                                                                                                     | ___/10 |



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|                     |                                                                                                                                                                                                    |                                                                                                                                                |                                                                                                                                              |         |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Group Participation | (4)<br>Did a full share of the work or more and volunteers to help others. Provided many good ideas; inspired others; clearly communicated ideas and needs. Completed assigned work ahead of time. | (3-2)<br>Did almost as much work as others. Participated in discussions; on some occasions, made suggestions. Completed assigned work on time. | (1)<br>Did less work than others. Listened mainly; Rarely spoke up, and ideas were off the mark. Needed much reminding; submission was late. | ___/4   |
| Ethics              | (4)<br>Upholds the standards of honesty and integrity. Addressed the societal and environmental issues and responsibilities.                                                                       | (3)<br>Upholds the standards of honesty and integrity. Addressed few societal and environmental issues.                                        | (2-1)<br>Upholds the standards of honesty and integrity.                                                                                     | ___/4   |
| Peer Review         | To be evaluated by other team members                                                                                                                                                              |                                                                                                                                                |                                                                                                                                              | ___/2   |
| Total               |                                                                                                                                                                                                    |                                                                                                                                                |                                                                                                                                              | ___/100 |

**Note:** The project will be evaluated for 100 marks and reduced to 50 marks.



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# **7<sup>th</sup>**

# **Semester**



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|                      |                            |                             |           |
|----------------------|----------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>7</b>                   |                             |           |
| <b>Course Title:</b> | <b>Network Programming</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS7PCNWP</b>          | <b>Total Contact Hours:</b> | <b>28</b> |
| <b>L-T-P:</b>        | <b>2-1-0</b>               | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Hours</b> |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Introduction to Network Programming:</b> OSI model, Unix standards, UDP, TCP, SCTP, TCP connection establishment and Termination, SCTP Connection establishment and termination, Port Numbers, Buffer sizes and limitations.<br><b>Sockets:</b> Address structures, value – result arguments, Byte ordering and manipulation function and related functions. Elementary TCP sockets.                                                  | <b>5</b>     |
| <b>2</b>        | <b>TCP client server:</b> Introduction, TCP Echo server, TCP Echo Client, Normal startup and Termination, Crashing and Rebooting of server host, Shutdown of server host.<br><b>Socket options:</b> getsockopt and setsockopt functions. Socket states, Generic socket options, IPV4 socket options, IPV6 socket options and TCP socket options, SCTP socket options, fcntl function.                                                    | <b>6</b>     |
| <b>3</b>        | <b>Elementary UDP sockets:</b> Introduction, UDP Echo server, UDP Echo Client, Verifying received response, summary of UDP example, Lack of flow control with UDP, determining outgoing interface with UDP.<br><b>Advanced I/O Functions:</b> Introduction, Socket Timeouts, recv and send Functions, readv and writev Functions, recvmsg and sendmsg Functions, Queuing of Data, Sockets and Standard I/O, T/TCP: TCP for Transactions. | <b>6</b>     |
| <b>4</b>        | <b>Streams:</b> Introduction, getmsg and putmsg functions, getpmsg and putpmsg functions, ioctl functions, Transport provider interface.<br><b>Broadcasting:</b> Introduction, Broadcast Addresses, Unicast versus Broadcast, dg_cli Function Using Broadcasting, Race Conditions.                                                                                                                                                       | <b>5</b>     |
| <b>5</b>        | <b>Multicasting:</b> Introduction, Multicast Addresses, Multicasting versus Broadcasting on A LAN, Multicasting on a WAN, Multicast Socket Options, mcast_join and Related Functions, dg_cli Function Using Multicasting, Receiving IP Multicast Infrastructure Session Announcements, Sending and Receiving, SNTP: Simple Network Time Protocol                                                                                         | <b>6</b>     |



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**Prescribed Text Book:**

| Sl. No. | Book Title               | Authors                                                 | Edition         | Publisher         | Year |
|---------|--------------------------|---------------------------------------------------------|-----------------|-------------------|------|
| 1       | UNIX Network Programming | W. Richard Stevens,<br>Bill Fenner,<br>Andrew M. Rudoff | 3 <sup>rd</sup> | Pearson Education | 2003 |

**Reference Text Books:**

| Sl. No. | Book Title                                                                   | Authors          | Edition         | Publisher           | Year |
|---------|------------------------------------------------------------------------------|------------------|-----------------|---------------------|------|
| 1       | Internetworking With TCP/IP<br>Vol I: Principles, Protocols and Architecture | Douglas E. Comer | 6 <sup>th</sup> | Pearson             | 2014 |
| 2       | Unix System Programming Using C++                                            | Terrence Chan    | 1 <sup>st</sup> | Prentice Hall India | 2011 |

**MOOC Course:**

| Sl. No. | Course name                | Course offered by | Year | URL                                                                                                   |
|---------|----------------------------|-------------------|------|-------------------------------------------------------------------------------------------------------|
| 1       | Socket Programming in Java | Mind Luster       | 2024 | <a href="https://www.mindluster.com/certificate/4049">https://www.mindluster.com/certificate/4049</a> |

**Course Outcomes (COs):**

|            |                                                       |
|------------|-------------------------------------------------------|
| <b>CO1</b> | Apply the fundamental concepts of network programming |
| <b>CO2</b> | Analyse the different network programming constructs  |
| <b>CO3</b> | Demonstrate the communication process in networks     |

**CO-PO-PSO Mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> |     |     | 3   |     |     |     |     |     | 2   | 2    |      |      | 2    |      |



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**Assessment Plan for CIE:**

| Tool                            | Remarks     | Marks |
|---------------------------------|-------------|-------|
| Internals                       | Best 2 of 3 | 40    |
| Quiz                            | --          | --    |
| Lab Component                   | --          | --    |
| Alternate Assessment Tool (AAT) | One         | 10    |
| Total                           |             | 50    |

**Tutorial Plan:**

| Tutorial #. | Unit #. | Topic                                                                                                                     |
|-------------|---------|---------------------------------------------------------------------------------------------------------------------------|
| 1           | 1       | Byte ordering, byte manipulation functions- Program to determine host byte order.                                         |
| 2           | 2       | Program to illustrate the use of socket functions such as Socket, connect, bind, listen, accept, fork and exec functions. |
| 3           | 2       | Demonstration of TCP/UDP Echo Client and TCP/UDP Echo Server.                                                             |
| 4           | 2       | Program to demonstrate different socket options supported.                                                                |
| 5           | 3       | Demonstrate the task of sending and receiving messages using socket functions.                                            |
| 6           | 4       | Demonstration of programs using Transport Provider Interface (TPI).                                                       |
| 7           | 5       | Program to demonstrate message broadcasting.                                                                              |
| 8           | --      | Design of the network scenario.                                                                                           |
| 9           | --      | Implementation of the network scenario to demonstrate the communication.                                                  |
| 10          | --      | Implementation of the network scenario to demonstrate the communication.                                                  |
| 11          | --      | Implementation of the network scenario to demonstrate the communication.                                                  |
| 12          | --      | Demonstration of the network scenario by student teams.                                                                   |



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**AAT Plan:**

Students are supposed to form a group with a team size of 3 to 4. The team has to choose an appropriate network scenario that demonstrates the communication between sender and receiver nodes and implement the same using the constructs learnt in C/C++ programming language.

| Sl. No | Week                                                                    | Activity                                                                     |
|--------|-------------------------------------------------------------------------|------------------------------------------------------------------------------|
| 1      | 1 <sup>st</sup> and 2 <sup>nd</sup>                                     | Formation of groups. Note: Student groups of size 3 to 4 members only        |
| 2      | 3 <sup>rd</sup> and 4 <sup>th</sup>                                     | AAT topic selection by each group                                            |
| 3      | 5 <sup>th</sup> , 6 <sup>th</sup> , 7 <sup>th</sup> and 8 <sup>th</sup> | Design of the chosen scenario                                                |
| 4      | 9 <sup>th</sup> , 10 <sup>th</sup> and 11 <sup>th</sup>                 | Implementation of the various functionalities of the chosen network scenario |
| 5      | 12 <sup>th</sup>                                                        | AAT Report Preparation and submission                                        |

**Evaluation Rubrics for AAT:**

| Criteria                                | Exemplary                                                                                                              | Proficient                                                                                                                    | Partially Proficient                                                                                            | Points |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--------|
| Selection of scenario for demonstration | (8-5)<br>The chosen scenario has an exceptional application. It demonstrates most of the network programming concepts. | (6-4)<br>The chosen scenario has an acceptable application. It demonstrates some of the network programming concepts.         | (3-1)<br>The chosen scenario has a simple application. It demonstrates few of the network programming concepts. | ___/8  |
| Implementation of the given scenario    | (12-8)<br>The scenario has been implemented using most of the networking constructs and with minimal errors.           | (7-4)<br>The scenario has been implemented using some of the networking constructs and with some errors.                      | (3-1)<br>The scenario has been implemented using minimal networking constructs and some errors.                 | ___/12 |
| Report                                  | (12-8)<br>Clear and effective writing and adherence to appropriate style guidelines.                                   | (7-4)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines. | (3-1)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines.      | ___/12 |



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|                                   |                                                             |                                  |                                 |              |
|-----------------------------------|-------------------------------------------------------------|----------------------------------|---------------------------------|--------------|
| Oral communication (presentation) | (4)<br>Clear and effective communication.                   | (3-2)<br>Communication is clear. | (1)<br>Unclear communication.   | __/4         |
| Participation in Discussions      | (4)<br>Answered all questions and provided many good ideas. | (3-2)<br>Answered all questions. | (1)<br>Answered some questions. | __/4         |
| <b>Total</b>                      |                                                             |                                  |                                 | <b>__/40</b> |

**Note:** AAT will be evaluated for 40 marks and reduced to 10 marks.



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|                      |                                        |                             |           |
|----------------------|----------------------------------------|-----------------------------|-----------|
| <b>Semester</b>      | <b>7</b>                               |                             |           |
| <b>Course Title:</b> | <b>Management and Entrepreneurship</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS7PCMNE</b>                      | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                           | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Hours</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <p><b>Introduction:</b> Definition of Management, Managing: Science or Art, Patterns of Management Analysis: A management theory jungle, The system approach to management process, The functions of managers.</p> <p><b>Planning:</b> Essentials of Planning and Managing by Objectives.</p>                                                                                                                                                                                                                                       | <b>8</b>     |
| <b>2</b>        | <p><b>Decision Making Organizing:</b> Formal and informal organization, Organizational Division, Organizational Levels and the span of management, Reengineering the organization, Structure and process of organizing; Line/Staff Authority, Empowerment and Decentralization.</p> <p><b>Leadership:</b> Defining Leadership, Ingredients of Leadership, Trait approaches to leadership, Leadership behaviour and styles.</p>                                                                                                      | <b>8</b>     |
| <b>3</b>        | <p><b>The Project Environment:</b> Internal and External Environment, Programs, Mission, Goals, Objectives and Strategy, Portfolios Management, Scoring Matrix, Financial Evaluation Criteria.</p> <p><b>Integration:</b> The Charter, Project Management Plan.</p> <p><b>Scope:</b> Beginning the Scope, Scope Contents, Triple Constraints, Priority Matrix, Scope Issues Sample Scope Statement.</p>                                                                                                                             | <b>9</b>     |
| <b>4</b>        | <p><b>Entrepreneurship:</b> Importance of entrepreneurship, concepts of entrepreneurship, characteristics of a successful entrepreneur, classification of entrepreneurs, myths of entrepreneurship, entrepreneurial development models, problems faced by entrepreneurs and capacity building for entrepreneurship.</p> <p><b>Women Entrepreneurs:</b> Women entrepreneurship defined, women entrepreneurship environment, challenges in the path of women entrepreneurship, strategies for development of women entrepreneurs.</p> | <b>8</b>     |
| <b>5</b>        | <p><b>Creativity and business idea:</b> Ideas from Trends analysis: Trends, sources of new ideas, methods of generating ideas.</p> <p><b>Innovation:</b> Entrepreneurial innovation, opportunity recognition, product planning and development process, eCommerce and business start-up.</p> <p><b>The Business plan:</b> What is business plan, who should write the plan, scope and value of business plan, Writing the business plan, Using and implementing the business plan.</p>                                              | <b>9</b>     |



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**Prescribed Text Books:**

| Sl. No. | Book Title                                              | Authors                                                                | Edition          | Publisher         | Year |
|---------|---------------------------------------------------------|------------------------------------------------------------------------|------------------|-------------------|------|
| 1       | Management: A Global and Entrepreneurial Perspective    | Heinz Weihrich, Mark V Cannice, Harold Koontz                          | 13 <sup>th</sup> | Tata McGraw Hill  | 2011 |
| 2       | The Art and Science of Project Management               | Roger Warburton, Vijay Kanabar                                         | 2 <sup>nd</sup>  | RW Press Newport  | 2013 |
| 3       | Entrepreneurship Development-Small Business Enterprises | Poornima M. Charantimath                                               | 1 <sup>st</sup>  | Pearson Education | 2009 |
| 4       | Entrepreneurship                                        | Robert D Hisrich, Mathew J Manimala, Michael P Peters, Dean A Shepherd | 9 <sup>th</sup>  | Tata McGraw Hill  | 2014 |

**Reference Text Books:**

| Sl. No. | Book Title                                                  | Authors                 | Edition         | Publisher                 | Year |
|---------|-------------------------------------------------------------|-------------------------|-----------------|---------------------------|------|
| 1       | Principles of Management                                    | P.C.Tripathi, P.N.Reddy | 7 <sup>th</sup> | Tata McGraw Hill          | 2021 |
| 2       | Dynamics of Entrepreneurial Development and Management      | Vasant Desai            | 1 <sup>st</sup> | Himalaya Publishing House | 2022 |
| 3       | Entrepreneurship Development                                | S.S. Khanka             | 1 <sup>st</sup> | S Chand                   | 2020 |
| 4       | Project Management for Business, Engineering and Technology | Nicholas J., Steyn      | 5 <sup>th</sup> | Elsevier                  | 2017 |



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**E-Books:**

| Sl. No. | Book Title                      | Authors                    | Edition         | Publisher                         | Year | URL                                                                                                                                                                                                                                                                                               |
|---------|---------------------------------|----------------------------|-----------------|-----------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.      | Management and Entrepreneurship | Veerabhadrapa Havinal      | 1 <sup>st</sup> | New Age International (P) Limited | 2009 | <a href="http://dspace.vnbrims.org:13000/xmlui/bitstream/handle/123456789/4983/Management%20and%20Entrepreneurship.pdf?sequence=1">http://dspace.vnbrims.org:13000/xmlui/bitstream/handle/123456789/4983/Management%20and%20Entrepreneurship.pdf?sequence=1</a>                                   |
| 2.      | Software Project Management     | Bob Hughes, Mike Cotterell | 2 <sup>nd</sup> | Tata McGraw Hill                  | 2009 | <a href="https://books.google.co.in/books?id=IMsvEAAQBAJ&amp;printec=frontcover&amp;source=gbgs_ge_summary_r&amp;cad=0#v=onepage&amp;q&amp;f=false">https://books.google.co.in/books?id=IMsvEAAQBAJ&amp;printec=frontcover&amp;source=gbgs_ge_summary_r&amp;cad=0#v=onepage&amp;q&amp;f=false</a> |

**MOOC Courses:**

| Sl. No. | Course name                                                 | Course offered by | Year | URL                                                                                                                                                                                                         |
|---------|-------------------------------------------------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Entrepreneurship Specialization                             | Coursera          | 2024 | <a href="https://www.coursera.org/specializations/wharton-entrepreneurship">https://www.coursera.org/specializations/wharton-entrepreneurship</a>                                                           |
| 2       | Professional Certificate in Innovation and Entrepreneurship | Edx               | 2024 | <a href="https://www.edx.org/certificates/professional-certificate/usmx-innovation-and-entrepreneurship">https://www.edx.org/certificates/professional-certificate/usmx-innovation-and-entrepreneurship</a> |
| 3       | Business Planning & Project Management                      | NPTEL             | 2020 | <a href="https://onlinecourses.swayam2.ac.in/cec20_mg07/preview">https://onlinecourses.swayam2.ac.in/cec20_mg07/preview</a>                                                                                 |
| 4       | Fundamentals of Project Planning and Management             | Coursera          | 2024 | <a href="https://www.coursera.org/learn/uva-darden-project-management">https://www.coursera.org/learn/uva-darden-project-management</a>                                                                     |



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### Course Outcomes (COs):

|            |                                                                                                                           |
|------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply appropriate Management and Entrepreneurial skills for managing business                                             |
| <b>CO2</b> | Analyse the different Management and Entrepreneurial strategies that aids in the effective functioning of an organization |
| <b>CO3</b> | Apply and Analyse Software Project management concepts for software development                                           |
| <b>CO4</b> | Design a business plan and estimate the plan using appropriate tool                                                       |

### CO-PO-PSO mapping:

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 3   |     |     |     |     |     |     |     |     |      |      | 3    |      |      |
| <b>CO2</b> |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> |     | 3   |     |     |     |     |     |     |     | 3    |      |      |      |      |
| <b>CO4</b> |     |     | 2   |     | 2   |     |     | 2   | 2   | 2    | 2    | 3    |      |      |

### Assessment Plan for CIE:

| Tool                                   | Remarks            | Marks     |
|----------------------------------------|--------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b> |
| <b>Quiz</b>                            | --                 | --        |
| <b>Lab Component</b>                   | --                 | --        |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>         | <b>10</b> |
| <b>Total</b>                           |                    | <b>50</b> |

### AAT Plan:

Students have to choose a topic of their interest such as e-commerce website, textile business, healthcare etc., and write a detailed business plan.

| Sl. No | Week                                                   | Activity                                                               |
|--------|--------------------------------------------------------|------------------------------------------------------------------------|
| 1      | 1 <sup>st</sup> and 2 <sup>nd</sup>                    | Formation of groups. Note: Student groups of size 3 to 4 members only. |
| 2      | 3 <sup>rd</sup>                                        | AAT topic selection by each group.                                     |
| 3      | 4 <sup>th</sup>                                        | Presentation: Student team and topic introduction by each group.       |
| 4      | 5 <sup>th</sup> , 6 <sup>th</sup> and 7 <sup>th</sup>  | First Review of business plans by student groups.                      |
| 5      | 8 <sup>th</sup> , 9 <sup>th</sup> and 10 <sup>th</sup> | Second review of estimation of the plan using appropriate tool.        |
| 6      | 11 <sup>th</sup> and 12 <sup>th</sup>                  | AAT Report Preparation and submission.                                 |



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**Rubrics used for evaluation:**

| Criteria                            | Exemplary                                                                                           | Proficient                                                                                                                    | Partially Proficient                                                                                       | Points        |
|-------------------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|---------------|
| Identify and design a business plan | (10-8)<br>Strong introduction of topic, clear delineation of business plan.                         | (7-4)<br>Conveys topic and business plan moderately.                                                                          | (3-0)<br>Doesn't effectively convey the topic and business plan.                                           | ___/10        |
| Selection of an appropriate tool    | (10-8)<br>The tool chosen supports the estimation of all the concepts for the chosen business plan. | (7-4)<br>The tool chosen supports the estimation of some of the concepts for the chosen business plan.                        | (3-0)<br>The tool chosen supports the estimation of few of the concepts for the chosen business plan.      | ___/10        |
| Report                              | (10-8)<br>Clear and effective writing and adherence to appropriate style guidelines.                | (7-4)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines. | (3-0)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines. | ___/10        |
| Oral communication (presentation)   | (5-4)<br>Clear and effective communication.                                                         | (3-2)<br>Communication is clear.                                                                                              | (1-0)<br>Unclear communication.                                                                            | ___/5         |
| Participation in Discussions        | (5-4)<br>Provided many good ideas; inspired others; clearly communicated Ideas.                     | (3-2)<br>Participated in discussions; on some occasions, made suggestions.                                                    | (1-0)<br>Listened mainly; Rarely spoke up, and ideas were off the mark.                                    | ___/5         |
| <b>Total</b>                        |                                                                                                     |                                                                                                                               |                                                                                                            | <b>___/40</b> |

Note: AAT will be evaluated for 40 marks and reduced to 10 marks.



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|                      |                              |                             |           |
|----------------------|------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>7/8</b>                   |                             |           |
| <b>Course Title:</b> | <b>Software Architecture</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS7PESWA/23CS8PESWA</b> | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                 | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Hours</b> |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <p><b>Introduction to Software Architecture:</b> Architectural Structures and Views<br/>Architectural Patterns, A Good Architecture.</p> <p><b>Contexts of Software Architecture:</b> Architecture in a Technical Context,<br/>Architecture in a Project Life-Cycle Context, Architecture in a Business Context,<br/>Architecture in a Professional Context, Stakeholders, Influence of Architecture.</p> <p><b>Understanding Quality Attributes:</b> Architecture and Requirements,<br/>Functionality, Quality Attribute Considerations, Specifying Quality Attribute<br/>Requirements, Achieving Quality Attributes through Tactics, Guiding Quality<br/>Design Decisions.</p> <p><b>Other Quality Attributes:</b> Other Important Quality Attributes, Other<br/>Categories of Quality Attributes, Software Quality Attributes and System<br/>Quality Attributes, Using Standard Lists of Quality Attributes or Not, dealing<br/>with "X-ability": Bringing a New Quality Attribute into the Fold.</p> | <b>8</b>     |
| <b>2</b>        | <p><b>Architectural Tactics and Patterns:</b> Architectural Patterns, Overview of the<br/>Patterns Catalogue, Relationships between Tactics and Patterns, Using Tactics<br/>Together.</p> <p><b>Quality Attribute Modelling and Analysis:</b> Modelling Architectures to Enable<br/>Quality Attribute Analysis, Quality Attribute Checklists, Thought Experiments<br/>and Back-of-the-Envelope Analysis, Experiments, Simulations, and Prototypes,<br/>Analysis at Different Stages of the Life Cycle.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>8</b>     |
| <b>3</b>        | <p><b>Architecture in Agile Projects:</b> Quantity of Architecture, Agility and<br/>Architecture Methods, A Brief Example of Agile Architecting, Guidelines for the<br/>Agile Architect.</p> <p><b>Architecture and Requirements:</b> Gathering ASRs from Requirements<br/>Documents, Gathering ASRs by Interviewing Stakeholders, Gathering ASRs by<br/>Understanding the Business Goals, Capturing ASRs in a Utility Tree, Tying the<br/>Methods Together.</p> <p><b>Designing an Architecture:</b> Design Strategy, The Attribute-Driven Design<br/>Method, The Steps of ADD.</p>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>9</b>     |

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|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 4 | <p><b>Documenting Software Architecture:</b> Uses and Audiences for Architecture Documentation, Notations for Architecture Documentation, Views, Choosing the Views, Combining Views Building the Documentation Package, Documenting Architecture in an Agile Development Project.</p> <p><b>Architecture Implementation and Testing:</b> Architecture and Implementation, Architecture and Testing.</p> <p><b>Architecture Evaluation</b> : Evaluation Factors, The Architecture Trade-off Analysis Method, Lightweight Architecture Evaluation.</p> | 9 |
| 5 | <p><b>Role of UML in software architecture.</b></p> <p><b>Economic Analysis of Architectures:</b> Decision-Making Context, The Basis for the Economic Analyses, Putting Theory into Practice: The CBAM, Case Study: The NASA ECS Project.</p> <p><b>Architecture and Software Product Lines:</b> An Example of Product Line Variability, working of a Software Product Line, Product Line Scope, The Quality Attribute of Variability, The Role of a Product Line Architecture, Variation Mechanisms, Evaluating a Product Line Architecture.</p>     | 8 |

**Prescribed Text Books:**

| Sl. No. | Book Title                        | Authors                                     | Edition         | Publisher      | Year |
|---------|-----------------------------------|---------------------------------------------|-----------------|----------------|------|
| 1       | Software Architecture in Practice | Len Basss,<br>Paul Clements,<br>Rick Kazman | 3 <sup>rd</sup> | Addison-Wesley | 2013 |

**References Text Books:**

| Sl. No. | Book Title                            | Authors                                                       | Edition         | Publisher      | Year |
|---------|---------------------------------------|---------------------------------------------------------------|-----------------|----------------|------|
| 1       | Software Architecture: The Hard Parts | Neal Ford,<br>Mark Richards, Pramod Sadalage, Zhamak Dehghani | 1 <sup>st</sup> | O'Reilly Media | 2021 |
| 2       | Software Architect's Handbook         | Joseph Ingeno                                                 | 1 <sup>st</sup> | Packt          | 2018 |

**MOOC Courses:**

| Sl. No. | Course Name           | Course Offered By | Year | URL                                                                                                                                         |
|---------|-----------------------|-------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Software Architecture | Coursera          | 2024 | <a href="https://www.coursera.org/learn/software-architecture">https://www.coursera.org/learn/software-architecture</a>                     |
| 2       | Software Architecture | Class Central     | 2024 | <a href="https://www.classcentral.com/course/software-architecture-9217">https://www.classcentral.com/course/software-architecture-9217</a> |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****Course Outcomes (COs):**

|            |                                                                                                          |
|------------|----------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the principles of software architecture and its qualities                                          |
| <b>CO2</b> | Analyze the principles and guidelines of software architectural design, styles, patterns, and frameworks |
| <b>CO3</b> | Demonstrate the effectiveness of using Software architecture techniques in application development       |

**CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3      | PO4      | PO5      | PO6 | PO7 | PO9 | PO10     | PO11 | PSO1     | PSO2 | PSO3 |
|------------|----------|----------|----------|----------|----------|-----|-----|-----|----------|------|----------|------|------|
| <b>CO1</b> | <b>3</b> |          |          |          |          |     |     |     |          |      |          |      |      |
| <b>CO2</b> |          | <b>3</b> |          |          |          |     |     |     |          |      | <b>2</b> |      |      |
| <b>CO3</b> |          |          | <b>2</b> | <b>2</b> | <b>2</b> |     |     |     | <b>2</b> |      | <b>2</b> |      |      |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>     | <b>Marks</b> |
|----------------------------------------|--------------------|--------------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b>    |
| <b>Quiz</b>                            | --                 | --           |
| <b>Lab Component</b>                   | --                 | --           |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>         | <b>10</b>    |
| <b>Total</b>                           |                    | <b>50</b>    |

**AAT Plan:**

The objective of AAT is to build a software system according to an architectural design by following each step in a defined architectural process. The team will implement architectural patterns currently used in industry and document the architecture system using UML diagrams.

| <b>Sl. No</b> | <b>Week</b>                                            | <b>Activity</b>                                                                                                                                  |
|---------------|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1             | 1 <sup>st</sup> and 2 <sup>nd</sup>                    | Formation of groups. Note: Student groups of size 2 to 4 members only                                                                            |
| 2             | 3 <sup>rd</sup>                                        | AAT topic selection by each group                                                                                                                |
| 3             | 4 <sup>th</sup>                                        | Presentation: Student team and topic introduction by each group                                                                                  |
| 4             | 5 <sup>th</sup> , 6 <sup>th</sup> and 7 <sup>th</sup>  | Identification of the significant modules, Architecture Designs, patterns and quality attributes for the proposed model.                         |
| 5             | 8 <sup>th</sup> , 9 <sup>th</sup> and 10 <sup>th</sup> | Demonstration of various functionalities of the proposed model utilizing the identified architectural design, patterns and quality requirements. |
| 6             | 11 <sup>th</sup> and 12 <sup>th</sup>                  | AAT Report Preparation                                                                                                                           |



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**Rubrics used for evaluation:**

| Criteria                                                                                                                                                                  | Exemplary                                                                                                       | Proficient                                                                                                         | Partially Proficient                                                                                              | Points        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------|
| Choose scenarios and design models to establish the business functionality for the software system. (The scenario must have at least three separate quality requirements) | (8-6)<br>Scenario chosen is appropriate and the model has all quality requirements.                             | (5-3)<br>Scenario chosen is appropriate and the model satisfies most of the quality requirements.                  | (2-1)<br>Scenario chosen is appropriate and the model caters limited quality requirements.                        | ___/8         |
| Identify and apply architectural tactics, patterns and software quality attributes.                                                                                       | (16-10)<br>Architectural tactics, patterns and relevant software quality attributes are identified and applied. | (9-5)<br>Identified and applied Architectural tactics, patterns and software quality attributes lack cohesiveness. | (4-1)<br>Identified and applied Architectural tactics, patterns and software quality attributes are incompatible. | ___/16        |
| Report                                                                                                                                                                    | (8-6)<br>Clear and Effective writing and adherence to appropriate style guidelines.                             | (5-3)<br>Writing is clear and effective, minor errors in adherence to appropriate style guidelines                 | (2-0)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines         | ___/8         |
| Oral communication (presentation)                                                                                                                                         | (4-3)<br>Clear and effective communication                                                                      | (2)<br>Communication is clear                                                                                      | (1-0)<br>Unclear communication                                                                                    | ___/4         |
| Participation in Discussions                                                                                                                                              | (4-3)<br>Provided many good ideas; inspired others; clearly communicated ideas.                                 | (2)<br>Participated in discussions; on some occasions, made suggestions.                                           | (1-0)<br>Listened mainly; Rarely spoke up, and ideas were off the mark.                                           | ___/4         |
| <b>Total</b>                                                                                                                                                              |                                                                                                                 |                                                                                                                    |                                                                                                                   | <b>___/40</b> |

**Note:** AAT will be evaluated for 40 marks and reduced to 10 marks.



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|                      |                              |                             |           |
|----------------------|------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>7/8</b>                   |                             |           |
| <b>Course Title:</b> | <b>Soft Computing</b>        |                             |           |
| <b>Course Code:</b>  | <b>23CS7PESCN/23CS8PESCN</b> | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                 | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                          | <b>Hours</b> |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Introduction:</b> Introduction, soft computing vs. hard computing, various types of soft computing techniques, and applications of soft computing. Basic tools of soft computing – Fuzzy logic, neural network, evolutionary computing. Introduction: Neural networks, application scope of neural networks, fuzzy logic, genetic algorithm, and hybrid systems                                     | <b>8</b>     |
| <b>2</b>        | <b>Fuzzy Sets and Logic:</b> Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications and Defuzzifications                                           | <b>9</b>     |
| <b>3</b>        | <b>Evolutionary Computing:</b> Basic Evolutionary Processes, EV: A Simple Evolutionary System, Evolutionary Systems as Problem Solvers, A Historical Perspective, Canonical Evolutionary Algorithms - Evolutionary Programming, Evolution Strategies, A Unified View of Simple EAs- A Common Framework, Population Size                                                                                | <b>9</b>     |
| <b>4</b>        | <b>Hybrid Soft Computing Techniques:</b> Introduction, Neuro Fuzzy Hybrid Systems, Comparison of Fuzzy Systems with Neural Networks, Characteristics of Neuro-Fuzzy Hybrids, Classification of Neuro Fuzzy Hybrid Systems, Genetic Neuro-Hybrid Systems: Properties of Genetic Neuro Hybrid Systems.                                                                                                   | <b>8</b>     |
| <b>5</b>        | <b>Neuro Fuzzy Modeling:</b><br><b>ANFIS:</b> Adaptive Neuro Fuzzy Inference Systems: Introduction, ANFIS Architecture, Hybrid Learning Algorithm, Learning Methods that cross fertilize ANFIS and RBFN, ANFIS as a Universal Approximator<br><b>Co-active Neuro Fuzzy Modeling:</b> Towards Generalized ANFIS: Introduction, Framework, Neuron Functions for Adaptive networks, Neuro Fuzzy Spectrum. | <b>8</b>     |



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**Prescribed Text Books:**

| Sl. No. | Book Title                                                                     | Authors                                     | Edition         | Publisher              | Year |
|---------|--------------------------------------------------------------------------------|---------------------------------------------|-----------------|------------------------|------|
| 1       | Principles of soft computing                                                   | S.N.Sivanandam,<br>S.N.Deepa                | 3 <sup>rd</sup> | Wiley India            | 2019 |
| 2       | Neuro-Fuzzy and Soft Computing                                                 | J. S. R. Jang,<br>C. T. Sun,<br>E. Mizutani | 1 <sup>st</sup> | Pearson Education      | 2004 |
| 3       | Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications | S. Rajsekaran,<br>G. A. Vijayalakshmi Pai   | 1 <sup>st</sup> | Prentice Hall of India | 2003 |
| 4       | Evolutionary Computation: A Unified Approach                                   | De Jong                                     | 1 <sup>st</sup> | MIT Press              | 2006 |

**Reference Text Books:**

| Sl. No. | Book Title                                                 | Authors                     | Edition         | Publisher      | Year |
|---------|------------------------------------------------------------|-----------------------------|-----------------|----------------|------|
| 1       | Soft Computing & Intelligent Systems Theory & Applications | N. K. Sinha,<br>M. M. Gupta | 1 <sup>st</sup> | Academic Press | 2009 |
| 2       | Computational Intelligence: Concepts to Implementation     | R. Eberhart,<br>Y. Shi      | 1 <sup>st</sup> | Morgan Kaufman | 2007 |
| 3       | Fuzzy Logic with engineering applications                  | Timothy J. Ross             | 3 <sup>rd</sup> | Wiley India    | 2011 |
| 4       | Computational Intelligence: An Introduction                | Andries P. Engelbrecht      | 2 <sup>nd</sup> | Wiley India    | 2009 |

**E-Books:**

| Sl. No. | Book Title                     | Authors            | Edition         | Publisher        | Year | URL                                                                                                                                             |
|---------|--------------------------------|--------------------|-----------------|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Fundamentals of Soft Computing | Dr. Kuntal Baruadr | 1 <sup>st</sup> | BPB Publications | 2017 | <a href="https://www.academia.edu/35476156/Fundamentals_of_Soft_Computing">https://www.academia.edu/35476156/Fundamentals_of_Soft_Computing</a> |



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|   |                                    |                         |                 |                                   |      |                                                                                                                                                                                                     |
|---|------------------------------------|-------------------------|-----------------|-----------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | Fuzzy Logic and Neural Networks by | Chennakesava R. Alavala | 1 <sup>st</sup> | New Age International (P) Limited | 2008 | <a href="https://www.academia.edu/1435724/Fuzzy_Logic_and_Neural_Networks_by_Chennakesava_R_Alavala">https://www.academia.edu/1435724/Fuzzy_Logic_and_Neural_Networks_by_Chennakesava_R_Alavala</a> |
|---|------------------------------------|-------------------------|-----------------|-----------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**MOOC Courses:**

| Sl. No. | Course name                     | Course Offered By | Year | URL                                                                                                                     |
|---------|---------------------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------------|
| 1       | Introduction To Soft Computing  | NPTEL             | 2021 | <a href="https://onlinecourses.nptel.ac.in/noc22_cs54/preview">https://onlinecourses.nptel.ac.in/noc22_cs54/preview</a> |
| 2       | Fuzzy Logic and Neural Networks | NPTEL             | 2018 | <a href="https://onlinecourses.nptel.ac.in/noc21_ge07/preview">https://onlinecourses.nptel.ac.in/noc21_ge07/preview</a> |

**Course Outcomes (COs):**

|            |                                                                                     |
|------------|-------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concepts of soft computing techniques to solve engineering problems       |
| <b>CO2</b> | Analyse the evolutionary algorithms and fuzzy logic reasoning to handle uncertainty |
| <b>CO3</b> | Demonstrate algorithms to solve combinatorial optimization problems                 |

**CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> |     |     | 2   |     |     |     |     | 2   | 2   |      |      |      |      |      |

**Assessment Plan for CIE:**

| Tool                                   | Remarks            | Marks     |
|----------------------------------------|--------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b> |
| <b>Quiz</b>                            | -                  | --        |
| <b>Lab Component</b>                   | --                 | --        |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>         | <b>10</b> |
| <b>Total</b>                           |                    | <b>50</b> |



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**AAT Plan:**

As an AAT for Soft computing course students will apply the soft computing techniques and evolutionary algorithms studied in the theory to solve combinatorial problems.

**Plan of Activities:** Following are the activities to be carried out by students:

| Sl. No | Week                                                   | Activity                                                                                 |
|--------|--------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1      | 1 <sup>st</sup> and 2 <sup>nd</sup>                    | Formation of groups: Student groups of size 3 to 4 is formed.                            |
| 2      | 3 <sup>rd</sup>                                        | Selection of problem statement by each group.                                            |
| 3      | 4 <sup>th</sup>                                        | Presentation: Introduction of the team and Introduction of the problem statement chosen. |
| 4      | 5 <sup>th</sup> and 6 <sup>th</sup>                    | Presentation of the Algorithm/technique to solve the problem.                            |
| 5      | 7 <sup>th</sup>                                        | Data pre-processing for solving the problem.                                             |
| 6      | 8 <sup>th</sup> , 9 <sup>th</sup> and 10 <sup>th</sup> | Design and development of the algorithm.                                                 |
| 7      | 11 <sup>th</sup>                                       | Report Preparation.                                                                      |
| 8      | 12 <sup>th</sup> and 13 <sup>th</sup>                  | Complete Solution Presentation and evaluation.                                           |

**Rubrics used for evaluation:**

| Criteria                                                                                                    | Exemplary                                                                                                                                                                             | Proficient                                                                                                                                               | Partially Proficient                                                                                               | Points |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------|
| Choosing the appropriate problem statement and the appropriate optimization technique to solve the problem. | (10-8)<br>Problem statement chosen is appropriate and the most appropriate optimization technique is used to solve the problem.                                                       | (7-5)<br>Problem statement chosen is appropriate but the optimization technique chosen to solve the problem is inappropriate.                            | (4-1)<br>Problem statement chosen is not optimization problem, the optimization technique chosen is inappropriate. | ___/10 |
| Implementation of the Algorithm and Testing for various inputs.                                             | (10-8)<br>Implementation of the optimization technique has been done accurately without the usage of any library functions and produces correct output for any given input in a team. | (7-5)<br>The team will Implement the optimization technique appropriately without the usage of any library functions, but not all test cases are passed. | (4-1)<br>The team will Implement the algorithm with usage of few library functions. Not all test cases are passed. | ___/10 |
| Application / Relevance                                                                                     | (10-8)<br>The optimized solution has several applications in real life.                                                                                                               | (7-5)<br>The solution designed has few applications in real life.                                                                                        | (4-1)<br>The designed solution has few applications and is not very relevant.                                      | ___/10 |



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|                         |                                                                                                                                                                       |                                                                                                                                                                |                                                                                                                                                                      |        |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Presentation and Report | (10-8)<br>Presents the solution clearly and confidently, with appropriate volume and pace. Clear and Effective writing and adherence to appropriate style guidelines. | (7-5)<br>Presents the solution with minor issues in volume or pace. Writing is clear and effective, minor errors in adherence to appropriate style guidelines. | (4-1)<br>Often unclear, with significant issues in volume or pace. Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines. | ___/10 |
| <b>Total</b>            |                                                                                                                                                                       |                                                                                                                                                                |                                                                                                                                                                      | ___/40 |

**Note:** AAT will be evaluated for 40 marks and reduced to 10 marks.



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|                      |                                    |                             |           |
|----------------------|------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>7/8</b>                         |                             |           |
| <b>Course Title:</b> | <b>Natural Language Processing</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS7PENLP/23CS8PENLP</b>       | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                       | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                               | <b>Hours</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Overview and language modelling</b><br><b>Overview:</b> Origins and challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications, Information Retrieval. Language Modelling: Various Grammar - based Language Models, Statistical Language Model.                                                                              | <b>8</b>     |
| <b>2</b>        | <b>Word level and syntactic analysis</b><br><b>Word Level Analysis:</b> Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and correction, Words and Word Classes, Part-of-Speech Tagging.<br><br><b>Syntactic Analysis:</b> Context-free Grammar, Constituency, Parsing, Probabilistic Parsing.                   | <b>9</b>     |
| <b>3</b>        | <b>Semantic analysis and Discourse processing</b><br><b>Semantic Analysis:</b> Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation.<br><br><b>Discourse Processing:</b> Cohesion, Reference Resolution, Discourse Coherence and Structure.                                                                                      | <b>8</b>     |
| <b>4</b>        | <b>Natural language generation and machine translation</b><br><b>Natural Language Generation:</b> Architecture of NLG Systems, Generation Tasks and Representations, Application of NLG, Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches, Translation involving Indian Languages. | <b>9</b>     |
| <b>5</b>        | <b>Application and lexical resources</b><br>Information Extraction, Automatic Text Categorization and Text Summarization, Question Answering System.<br><br><b>Lexical Resources:</b> Word Net, Frame Net, Stemmers, Research Corpora.                                                                                                                      | <b>8</b>     |

**Prescribed Text Book:**

| <b>Sl. No.</b> | <b>Book Title</b>                                     | <b>Authors</b>                | <b>Edition</b>  | <b>Publisher</b>        | <b>Year</b> |
|----------------|-------------------------------------------------------|-------------------------------|-----------------|-------------------------|-------------|
| <b>1</b>       | Natural Language Processing and Information Retrieval | Tanveer Siddiqui, U.S. Tiwary | 1 <sup>st</sup> | Oxford University Press | 2008        |



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**Reference Text Books:**

| Sl. No. | Book Title                                                                                                                       | Authors                                      | Edition         | Publisher     | Year |
|---------|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-----------------|---------------|------|
| 1       | Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition | Daniel Jurafsky, James H Martin              | 3 <sup>rd</sup> | Prentice Hall | 2019 |
| 2       | Natural Language Processing: Python and NLTK                                                                                     | Deepti Chopra, Jacob Perkins, NitinHardeniya | 1 <sup>st</sup> | Packt         | 2016 |

**MOOC Courses:**

| Sl. No. | Course name                 | Course Offered By | Year | URL                                                                                                     |
|---------|-----------------------------|-------------------|------|---------------------------------------------------------------------------------------------------------|
| 1       | Natural Language Processing | NPTEL             | 2012 | <a href="https://nptel.ac.in/courses/106101007/">https://nptel.ac.in/courses/106101007/</a>             |
| 2       | Natural Language Processing | NPTEL             | 2023 | <a href="https://onlinecourses.nptel.ac.in/noc23_cs80">https://onlinecourses.nptel.ac.in/noc23_cs80</a> |

**Course Outcomes (COs):**

|            |                                                                           |
|------------|---------------------------------------------------------------------------|
| <b>CO1</b> | Apply various Natural language processing techniques                      |
| <b>CO2</b> | Analyse the different Natural language processing techniques              |
| <b>CO3</b> | Design and develop an application using Natural Language Processing tools |

**CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> |     |     | 2   |     | 2   |     |     | 2   | 2   |      |      |      |      | 2    |

**Assessment Plan for CIE:**

| Tool                                   | Remarks            | Marks     |
|----------------------------------------|--------------------|-----------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b> |
| <b>Quiz</b>                            | --                 | --        |
| <b>Lab Component</b>                   | --                 | --        |
| <b>Alternate Assessment Tool (AAT)</b> | <b>One</b>         | <b>10</b> |
| <b>Total</b>                           |                    | <b>50</b> |



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**AAT Plan:**

Students are required to explore key problems that NLP can address and develop an NLP application using TensorFlow, PyTorch, spaCy and NLTK libraries. A report must be submitted in the specified format.

| Sl. No | Week                                                   | Activity                                                                                                                             |
|--------|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| 1      | 1 <sup>st</sup> and 2 <sup>nd</sup>                    | Formation of groups. Note: Student groups of size 3 to 4 members only.                                                               |
| 2      | 3 <sup>rd</sup>                                        | AAT topic selection by each group.                                                                                                   |
| 3      | 4 <sup>th</sup>                                        | Presentation: Student team and topic introduction by each group.                                                                     |
| 4      | 5 <sup>th</sup> , 6 <sup>th</sup> and 7 <sup>th</sup>  | Demonstration of the significant modules of the Natural processing Techniques through simple case studies.                           |
| 5      | 8 <sup>th</sup> , 9 <sup>th</sup> and 10 <sup>th</sup> | Demonstration of the various functionalities validating the different scenario chosen in the natural language processing techniques. |
| 6      | 11 <sup>th</sup> and 12 <sup>th</sup>                  | AAT Report Preparation.                                                                                                              |

**Rubrics used for evaluation:**

| Criteria                                                                                                                                            | Exemplary                                                                                                                            | Proficient                                                                                                                               | Partially Proficient                                                                                                                     | Points |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Selection of scenario for demonstration.                                                                                                            | (8-6)<br>The chosen scenario has an exceptional application. It demonstrates most of natural language processing techniques.         | (5-3)<br>The chosen scenario has an acceptable application. It demonstrates some of natural language processing techniques.              | (2-0)<br>The chosen scenario has a simple application. It demonstrates few of natural language processing techniques.                    | ___/8  |
| Ability to exhibit integrity and ethical behavior while exploring the chosen natural processing techniques to validate the various Functionalities. | (8-6)<br>Able to effectively exhibit integrity and ethical behavior in the chosen NLP technique to validate all the functionalities. | (5-3)<br>Able to effectively exhibit integrity and ethical behavior in the chosen NLP technique to validate most of the functionalities. | (2-0)<br>Able to effectively exhibit integrity and ethical behavior in the chosen NLP technique to validate some of the functionalities. | ___/8  |



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|                                                                  |                                                                                                                                       |                                                                                                                                    |                                                                                                                                    |        |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------|
| Development of an application for the given Problem Requirement. | (8-6)<br>Development of the application has been done comprehensively using natural language processing techniques with valid output. | (5-3)<br>Development of the application has been done moderately using natural language processing techniques with partial output. | (2-0)<br>Development of the application has been done moderately using natural language processing techniques with Invalid output. | ___/8  |
| Report                                                           | (8-6)<br>Clear and effective writing and adherence to appropriate style guidelines.                                                   | (5-3)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines.      | (2-0)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines.                         | ___/8  |
| Oral communication (presentation)                                | (4-3)<br>Clear and effective communication.                                                                                           | (2)<br>Communication is clear.                                                                                                     | (1-0)<br>Unclear communication.                                                                                                    | ___/4  |
| Participation in Discussions                                     | (4-3)<br>Provided many good ideas; inspired others; clearly communicated Ideas.                                                       | (2)<br>Participated in discussions occasionally and made few suggestions.                                                          | (1-0)<br>Listened mainly; Rarely spoke up, and ideas were off the mark.                                                            | ___/4  |
| <b>Total</b>                                                     |                                                                                                                                       |                                                                                                                                    |                                                                                                                                    | ___/40 |

**Note:** AAT will be evaluated for 40 marks and reduced to 10 marks.



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|                      |                                          |                       |           |
|----------------------|------------------------------------------|-----------------------|-----------|
| <b>Semester:</b>     | <b>7/8</b>                               |                       |           |
| <b>Course Title:</b> | <b>Wireless and Mobile Communication</b> |                       |           |
| <b>Course Code:</b>  | <b>23CS7PEWMC/23CS8PEWMC</b>             | <b>Total Contact</b>  | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                             | <b>Total Credits:</b> | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                               | <b>Hours</b> |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Applications and requirements of wireless services:</b> History, Types of Services, Requirements for the services, Economic and social aspects.<br><b>Technical Challenges of wireless communications:</b> Multipath propagation, Spectrum limitations, Limited energy, User mobility.                                                                                                   | <b>8</b>     |
| <b>2</b>        | <b>Cellular Wireless Networks:</b> Principles of cellular networks, First-General Analog, Second generation TDMA, Second generation CDMA, Third generation systems.<br><b>Antennas and wave propagation:</b> Antennas, Propagation Modes.<br><b>Wireless Systems Operations and Standards:</b> Cordless systems, Wireless local loop, WiMAX and 802.16 broadband wireless access standards. | <b>9</b>     |
| <b>3</b>        | <b>Wireless LAN Technology:</b> Overview, Infrared LANs.<br><b>Wi-Fi and IEEE 802.11:</b> IEEE 802.11 Architecture, IEEE 802.11 Architecture and services<br><b>Bluetooth and IEEE 802.15:</b> Overview, Radio Specification, <b>IEEE 802.15 - IEEE 802.15.3-</b> Medium access control.                                                                                                    | <b>9</b>     |
| <b>4</b>        | <b>Telecommunication Systems:</b> GSM, TETRA, UMTS and IMT-2000.<br><b>Satellite Systems:</b> Applications, Basics, Routing, Localisations, Handover.<br><b>Mobile IP and Wireless Application Protocol:</b> Mobile IP, Wireless Application Protocol                                                                                                                                       | <b>8</b>     |
| <b>5</b>        | <b>Mobile Transport Layer:</b> Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks.<br><b>Support for Mobility:</b> World Wide Web, Wireless Application Protocol (version 1.x), WAP 2.0.                                                                                                                                                                        | <b>8</b>     |

**Prescribed Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                    | <b>Authors</b>    | <b>Edition</b>  | <b>Publisher</b> | <b>Year</b> |
|----------------|--------------------------------------|-------------------|-----------------|------------------|-------------|
| 1              | Wireless Communications              | Andreas F Molisch | 1 <sup>st</sup> | Wiley, India     | 2010        |
| 2              | Wireless Communications and Networks | William Stallings | 2 <sup>nd</sup> | Pearson          | 2013        |
| 3              | Mobile Communications                | Joschen Schiller  | 2 <sup>nd</sup> | Pearson          | 2014        |



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**Reference Books:**

| Sl. No | Book Title                                                 | Authors               | Edition         | Publisher                | Year |
|--------|------------------------------------------------------------|-----------------------|-----------------|--------------------------|------|
| 1      | Wireless Communications Principles and practices           | Theodore S. Rappaport | 2 <sup>nd</sup> | Pearson                  | 2018 |
| 2      | Mobile Communications Engineering: Theory and Applications | William C. Y. Lee     | 2 <sup>nd</sup> | McGraw-Hill Publications | 2017 |

**E-Book:**

| Sl. No. | Book Title                     | Authors       | Edition         | Publisher | Year | URL                                                                                                                                                                               |
|---------|--------------------------------|---------------|-----------------|-----------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Wireless and Mobile Networking | Mahbub Hassan | 1 <sup>st</sup> | CRC Press | 2022 | <a href="https://www.researchgate.net/publication/360956823_Wireless_and_Mobile_Networking">https://www.researchgate.net/publication/360956823_Wireless_and_Mobile_Networking</a> |

**MOOC Courses:**

| Sl. No. | Course name                                          | Course offered by | Year | URL                                                                                                             |
|---------|------------------------------------------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------|
| 1       | Introduction To Wireless and Cellular Communications | NPTEL             | 2023 | <a href="https://nptel.ac.in/courses/106106167">https://nptel.ac.in/courses/106106167</a>                       |
| 2       | Wireless Network                                     | Udemy             | 2023 | <a href="https://www.udemy.com/course/wireless-network-q/">https://www.udemy.com/course/wireless-network-q/</a> |

**Course Outcomes (COs):**

|            |                                                                                        |
|------------|----------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the concepts of cellular, wireless and mobile standards in wireless environments |
| <b>CO2</b> | Analyse the functionalities of various wireless technologies                           |
| <b>CO3</b> | Explore a network simulator and demonstrate the working of a wireless scenario         |

**CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3 | PO4      | PO5      | PO6 | PO7 | PO8 | PO9      | PO10     | PO11 | PSO1 | PSO2     | PSO3 |
|------------|----------|----------|-----|----------|----------|-----|-----|-----|----------|----------|------|------|----------|------|
| <b>CO1</b> | <b>3</b> |          |     |          |          |     |     |     |          |          |      |      |          |      |
| <b>CO2</b> |          | <b>2</b> |     |          |          |     |     |     |          |          |      |      |          |      |
| <b>CO3</b> |          |          |     | <b>1</b> | <b>3</b> |     |     |     | <b>2</b> | <b>2</b> |      |      | <b>2</b> |      |



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**Assessment Plan for CIE:**

| Tool                            | Remarks     | Marks     |
|---------------------------------|-------------|-----------|
| Internals                       | Best 2 of 3 | 40        |
| Quiz                            | --          | --        |
| Lab Component                   | --          | --        |
| Alternate Assessment Tool (AAT) | One         | 10        |
| <b>Total</b>                    |             | <b>50</b> |

**AAT Plan:**

Students are supposed to explore any of the network simulators and demonstrate the working of a wireless scenario. A report has to be submitted in the prescribed format. Also, a demonstration of simulated scenarios (preferably with code) along with a report has to be submitted.

| Sl. No | Week                                                   | Activity                                                                                                              |
|--------|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| 1      | 1 <sup>st</sup> and 2 <sup>nd</sup>                    | Formation of groups. Note: Student groups of size 3 to 4 members only.                                                |
| 2      | 3 <sup>rd</sup>                                        | AAT topic selection by each group.                                                                                    |
| 3      | 4 <sup>th</sup>                                        | Presentation: Student team and topic introduction by each group.                                                      |
| 4      | 5 <sup>th</sup> , 6 <sup>th</sup> and 7 <sup>th</sup>  | Demonstration of the significant modules of the network simulators through simple case studies.                       |
| 5      | 8 <sup>th</sup> , 9 <sup>th</sup> and 10 <sup>th</sup> | Demonstration of the various functionalities validating the wireless scenario chosen in the chosen network simulator. |
| 6      | 11 <sup>th</sup> and 12 <sup>th</sup>                  | AAT Report Preparation.                                                                                               |

**Rubrics used for evaluation:**

| Criteria                                | Exemplary                                                                                                                 | Proficient                                                                                                               | Partially Proficient                                                                                               | Points |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------|
| Selection of scenario for demonstration | (8-6)<br>The chosen scenario has an exceptional application. It demonstrates most of the wireless communication concepts. | (5-3)<br>The chosen scenario has an acceptable application. It demonstrates some of the wireless communication concepts. | (2-0)<br>The chosen scenario has a simple application. It demonstrates few of the wireless communication concepts. | ___/8  |



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|                                                                                                                      |                                                                                                                |                                                                                                                              |                                                                                                                   |        |
|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------|
| Selection of an appropriate Network simulator                                                                        | (8-6)<br>The network simulator chosen supports the implementation of all the concepts for the chosen scenario. | (5-3)<br>The network simulator chosen supports the implementation of most of the concepts for the chosen scenario.           | (2-0)<br>The network simulator chosen supports the implementation of few of the concepts for the chosen scenario. | ___/8  |
| Exploration of the chosen network simulator to validate the various functionalities involved in the chosen scenario. | (8-6)<br>The chosen simulator has been explored in depth to validate all the functionalities chosen.           | (5-3)<br>The chosen simulator has been explored to validate most of the functionalities chosen.                              | (2-0)<br>The chosen simulator has been explored to validate some of the functionalities chosen.                   | ___/8  |
| Report                                                                                                               | (8-6)<br>Clear and effective writing and adherence to appropriate style guidelines                             | (5-3)<br>Writing that is clear and effective for the most part and minor errors in adherence to appropriate style guidelines | (2-0)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate style guidelines         | ___/8  |
| Oral communication (presentation)                                                                                    | (4-3)<br>Clear and effective communication                                                                     | (2)<br>Communication is clear                                                                                                | (1-0)<br>Unclear communication                                                                                    | ___/4  |
| Participation in Discussions                                                                                         | (4-3)<br>Provided many good ideas; inspired others; clearly communicated Ideas.                                | (2)<br>Participated in discussions; on some occasions, made suggestions.                                                     | (1-0)<br>Listened mainly; Rarely spoke up, and ideas were off the mark.                                           | ___/4  |
| <b>Total</b>                                                                                                         |                                                                                                                |                                                                                                                              |                                                                                                                   | ___/40 |

**Note:** AAT will be evaluated for 40 marks and reduced to 10 marks.



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|                      |                                |                             |           |
|----------------------|--------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>7/8</b>                     |                             |           |
| <b>Course Title:</b> | <b>MOOC/<br/>NPTEL Courses</b> |                             |           |
| <b>Course Code:</b>  | <b>25MC70EXXX</b>              | <b>Total Contact Hours:</b> | <b>--</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                   | <b>Total Credits:</b>       | <b>3</b>  |

**Guidelines:**

- Students are eligible to enroll in AICTE-approved 12-week NPTEL courses with proctored examinations.
- A student can enroll and complete the course during 3<sup>rd</sup> or 4<sup>th</sup> year of his/her study. However, he/she may claim only one NPTEL course per semester for credit transfer as per the scheme.
- A 12-week NPTEL course will be equivalent to 3 institute credits at institute level.
- Students must obtain prior approval from the department's NPTEL course Coordinator, and the Head of the Department.
- Strict monitoring of the student progress in the registered NPTEL course will be done by the student's proctor, department's NPTEL course Coordinator and the Head of the Department.

**Assessment:**

- Students must appear for the NPTEL proctored final examination and the Grades obtained will be mapped to the institute's grading system as follows:

| <b>NPTEL Score</b> | <b>Institute Grade</b> | <b>Grade Point</b>   |
|--------------------|------------------------|----------------------|
| <b>90—100</b>      | <b>O</b>               | <b>10</b>            |
| <b>80—89</b>       | <b>A+</b>              | <b>9</b>             |
| <b>70—79</b>       | <b>A</b>               | <b>8</b>             |
| <b>60—69</b>       | <b>B+</b>              | <b>7</b>             |
| <b>50—59</b>       | <b>B</b>               | <b>6</b>             |
| <b>45—49</b>       | <b>C</b>               | <b>5</b>             |
| <b>40-44</b>       | <b>D</b>               | <b>4</b>             |
| <b>Below 40</b>    | <b>F (Fail)</b>        | <b>0 (No Credit)</b> |

- If a student scores below 40%, the course shall be marked as F (Fail), and no credits will be transferred.
- The student must then take the NPTEL course in the next academic term as per institute academic policies.
- At the end of 8<sup>th</sup> semester, if a student fails to clear the NPTEL course, special provision may be provided as the NPTEL supplementary exam guideline which states that CIE of NPTEL to be considered and SEE to be conducted by the institution based on the NPTEL curriculum and assignments of the respective course.



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|                      |                              |                       |          |
|----------------------|------------------------------|-----------------------|----------|
| <b>Semester:</b>     | <b>7</b>                     |                       |          |
| <b>Course Title:</b> | <b>Major Project Phase-2</b> |                       |          |
| <b>Course Code:</b>  | <b>23CS7PWPP2</b>            |                       |          |
| <b>L-T-P:</b>        | <b>0-0-7</b>                 | <b>Total Credits:</b> | <b>7</b> |

**Guidelines:**

1. Preparation of detailed design for the project (Continuation of Major Project Phase 1).
2. Implementation of the sub-modules and their integration.
3. Testing and validation.
4. Preparation and publication of implementation paper.
5. Preparation and submission of Major Project Phase 2 report.
  - In-house project teams should meet their Guides weekly and update about the progress of the projects, whereas the industry project students meet their Guides once in fifteen days.
  - CIE evaluation: Carried out twice in a semester by an internal panel comprising of Internal Guide and three other faculty members of the department.
  - SEE evaluation: Conducted at the end of the seventh semester by both internal guide and an external examiner from other institutions.
  - Evaluation is based on the demonstration of the working project by the team, project report and publication.

**Note:** CIE will be evaluated for 100 Marks and will be reduced to 50 Marks.

**Course Outcomes (COs):**

|            |                                                                                                                                                                                                                                |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the software engineering principles in planning, formulating an innovative design/ approach and computing the requirements appropriate to chosen topic within the context of legal, societal and environment constraint. |
| <b>CO2</b> | Apply the concepts of mathematics, science and engineering to implement the project and draw conclusions out of the results, while exhibiting integrity and ethical behaviour in engineering practice.                         |
| <b>CO3</b> | Monitor, manage project schedules, resources and work assignments to ensure timely completion.                                                                                                                                 |



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|            |                                                                                                                                                        |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO4</b> | Test and defend performance of the implemented project and understand the implication of the solution.                                                 |
| <b>CO5</b> | Perform individually as well as in a team, accepting responsibility, taking initiative, and providing leadership, necessary to ensure project success. |
| <b>CO6</b> | Use formal and informal communications with team members and guide, make presentations and prepare technical document.                                 |

### **CO-PO-PSO mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> |     | 2   | 2   |     |     | 2   | 2   |     |     |      | 2    | 2    |      |      |
| <b>CO2</b> | 3   |     |     | 3   | 3   |     |     | 3   |     |      |      |      | 3    | 3    |
| <b>CO3</b> |     |     |     |     |     |     |     |     |     |      | 3    |      |      |      |
| <b>CO4</b> |     |     |     |     |     |     | 1   |     |     |      |      | 1    |      |      |
| <b>CO5</b> |     |     |     |     |     |     |     |     | 1   |      | 1    |      |      |      |
| <b>CO6</b> |     |     |     |     |     |     |     |     |     | 1    | 1    |      |      |      |

### **Assessment Plan for CIE:**

| <b>Tool</b>                | <b>Remarks</b> | <b>Marks</b> |
|----------------------------|----------------|--------------|
| <b>Evaluation by Guide</b> | --             | <b>50</b>    |
| <b>Evaluation by Panel</b> | --             | <b>48</b>    |
| <b>Peer Evaluation</b>     | --             | <b>2</b>     |
| <b>Total</b>               |                | <b>100</b>   |

### **Rubrics for Project Evaluation:**

| <b>Criteria</b> | <b>Exemplary</b> | <b>Proficient</b> | <b>Partially Proficient</b> | <b>Points</b> |
|-----------------|------------------|-------------------|-----------------------------|---------------|
|-----------------|------------------|-------------------|-----------------------------|---------------|



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|                 |                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                            |        |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Planning        | (15)<br>Project schedule:<br>Progress, milestones and deliverables with realistic estimates of the time (Gant chart).<br>Identify resources: (hardware and software) required to accomplish the development effort.<br>Cost estimates of hardware and software.                                                                                                                                                    | (14-6)<br>Project schedule:<br>Progress, milestones and deliverables (Gant chart).<br>Identify resources: (hardware and software) required to accomplish the development effort.<br>Cost estimates of hardware and software.                                                                                                                                                              | (5-1)<br>Project schedule:<br>Progress, milestones and deliverables are not planned accordingly.<br>Identify resources: (hardware and software) required to accomplish the development effort.<br>Cost estimates of hardware and software. | ___/15 |
| Detailed Design | (15)<br>Design is as per problem formulation.<br>Architectural design/<br>System design: identifying the sub-systems. Abstract specification of the sub-systems, Interface design<br>Carefully chosen a methodology or approach that is well-suited to the formulated problem.                                                                                                                                     | (6-14)<br>Design is as per problem formulation.<br>Architectural design/<br>System design: identifying the sub-systems. Abstract specification of the sub-systems, Interface design.                                                                                                                                                                                                      | (1-5)<br>Design does not target the problem formulation optimally.<br>Architectural design/<br>System design: identifying the sub-systems. Abstract specification of the sub-systems, Interface design.                                    | ___/15 |
| Implementation  | (25) Completed implementation for all set objectives as per the design and specification; justifying latest tools and techniques used.<br>Implementation of methodology/approaches/ technique is Sustainable, innovative and is specific to the needs of the project and robust to cater to future enhancements.<br>Showed competency in developing the system and fulfilled the objectives in the given timeline. | (24-15)<br>Completed implementation for all set objectives as per the design and specification; justifying latest tools and techniques used.<br>Implementation of methodology/approaches/ technique is specific to the needs of the project and robust to cater to future enhancements.<br>Showed competency in developing the system and fulfilled the objectives in the given timeline. | (14-1)<br>Completed implementation for all set objectives as per the design and specification; justifying latest tools and techniques used.<br>Did not adhere to the given timeline.                                                       | ___/25 |



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|                                     |                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                    |        |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Testing and Validation              | (5)<br>Data interpretation, integration, analysis and test results interpreted clearly. Included high quality charts, tables, graphs, images, etc. to assist in interpreting the results and closes with a strong conclusion.                              | (4-3)<br>Data interpretation, integration, analysis and test results interpreted clearly. Included high quality charts, tables, graphs, images, etc. to assist in interpreting the results.                                                                                                               | (2-1)<br>Data interpretation, integration, analysis and test results lacks clarity.                                                                                                                                                                                                | ___/5  |
| Publication of Implementation Paper | (5)<br>Prepared and received acceptance for Implementation Paper                                                                                                                                                                                           | (4-3)<br>Prepared Implementation Paper                                                                                                                                                                                                                                                                    | (2-1)<br>Not Prepared Implementation Paper                                                                                                                                                                                                                                         | ___/5  |
| Report                              | (15)<br>Clear and Effective writing and adherence to appropriate report format. All figures, graphs, charts, and drawings are accurate, consistent with the text, and of good quality. They enhance understanding of the text. All are labelled correctly. | (14-6)<br>Writing that is clear and effective for most part and minor errors in adherence to appropriate report format, all figures, graphs, charts, and drawings are accurate, consistent with the text, and of good quality. They enhance understanding of the text. All are labelled correctly. [6-14] | (5-1)<br>Unclear and ineffective writing and multiple errors in adherence to appropriate report format. All figures, graphs, charts, and drawings are accurate, consistent with the text, and of good quality. They enhance understanding of the text. All are labelled correctly. | ___/15 |
| Oral communication                  | (10)<br>Clear and effective communication. Presentation includes appropriate contents and is clearly organized. Presentation highlights key ideas and closes with a strong conclusion. Answer questions/queries professionally.                            | (9-6)<br>Communication is clear. Presentation includes appropriate contents and is clearly organized. Presentation highlights key ideas. Answer questions/queries professionally.                                                                                                                         | (5-1)<br>Unclear communication. Presentation includes appropriate contents. Presentation highlights key ideas.                                                                                                                                                                     | ___/10 |



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|                     |                                                                                                                                                                                                          |                                                                                                                                                      |                                                                                                                                                    |         |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Group Participation | (4)<br>Did a full share of the work or more and volunteers to help others?<br>Provided many good ideas; inspired others; clearly communicated ideas and needs.<br>Completed assigned work ahead of time. | (3-2)<br>Did almost as much work as others.<br>Participated in discussions; on some occasions, made suggestions.<br>Completed assigned work on time. | (1)<br>Did less work than others.<br>Listened mainly; Rarely spoke up, and ideas were off the mark.<br>Needed much reminding; submission was late. | ___/4   |
| Ethics              | (4)<br>Upholds the standards of honesty and integrity.<br>Addressed the societal and environmental issues and responsibilities.                                                                          | (3)<br>Upholds the standards of honesty and integrity.<br>Addressed few societal and environmental issues                                            | (2-1)<br>Upholds the standards of honesty and integrity.                                                                                           | ___/4   |
| Peer Review         | Peer evaluation by team members                                                                                                                                                                          |                                                                                                                                                      |                                                                                                                                                    | ___/2   |
| Total               |                                                                                                                                                                                                          |                                                                                                                                                      |                                                                                                                                                    | ___/100 |

**Note:** The Project will be evaluated for 100 Marks and reduced to 50 Marks.



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|                      |                                 |                       |          |
|----------------------|---------------------------------|-----------------------|----------|
| <b>Sem.:</b>         | <b>7</b>                        |                       |          |
| <b>Course Title:</b> | <b>Indian Knowledge Systems</b> |                       |          |
| <b>Course Code:</b>  | <b>25MA7HSIKL</b>               |                       |          |
| <b>L-T-P:</b>        | <b>1-0-0</b>                    | <b>Total Credits:</b> | <b>1</b> |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                        | <b>Hours</b> |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge                | <b>5</b>     |
| <b>2</b>        | Traditional Knowledge in Humanities and Sciences: Linguistics, Number and measurements- Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology                         | <b>5</b>     |
| <b>3</b>        | Traditional Knowledge in Professional domain: Town planning and architecture Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals | <b>5</b>     |

**Prescribed/Reference Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                                                  | <b>Authors</b>                                       | <b>Edition</b> | <b>Publisher</b>                             | <b>Year</b> |
|----------------|--------------------------------------------------------------------|------------------------------------------------------|----------------|----------------------------------------------|-------------|
| 1              | Introduction to Indian Knowledge System- concepts and applications | B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N | 1st            | PHI Learning Private Ltd                     | 2022        |
| 2              | Traditional Knowledge System in India                              | Amit Jha                                             | 1st            | Atlantic Publishers and Distributors (P) Ltd | 2009        |
| 3              | Knowledge Traditions and Practices of India                        | Kapil Kapoor, Avadesh Kumar Singh                    | 1st            | DK Print World (P) Ltd                       | 2005        |



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**E-Book: Suggested Web Links**

| Sl. No. | Book Title                                                                                                 | Authors                          | Edition | Publisher       | Year | URL                                                                                                                                                                                 |
|---------|------------------------------------------------------------------------------------------------------------|----------------------------------|---------|-----------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | What can we learn from Indian Knowledge Systems                                                            | Michel Danino                    | -       | IIT Gandhinagar | 2016 | <a href="https://www.youtube.com/watch?v=LZP1StpYEPm">https://www.youtube.com/watch?v=LZP1StpYEPm</a>                                                                               |
| 2       | Ayurvedic Inheritance of India                                                                             | Dr M. S. Valiathan               | -       | IIT Madras      | 2013 | <a href="http://nptel.ac.in/courses/121106003/">http://nptel.ac.in/courses/121106003/</a>                                                                                           |
| 3       | Centre of Excellence for Indian Knowledge System                                                           | -                                | -       | IIT Kharagpur   | -    | <a href="http://www.iitkgp.ac.in/departments/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63">http://www.iitkgp.ac.in/departments/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63</a> |
| 4       | Protecting and Promoting Traditional Knowledge: Systems, National Experiences and International Dimensions | Sophia Twarog and Promila Kapoor | -       | -               | 2004 | <a href="https://unctad.org/system/files/official-document/ditcted10_en.pdf">https://unctad.org/system/files/official-document/ditcted10_en.pdf</a>                                 |
| 5       | Biological Diversity and Traditional Knowledge                                                             | Prof S. Kannaiyan                | -       | -               | -    | <a href="http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf">http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf</a>                                   |



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**MOOC Courses:**

| Sl. No. | Course name                    | Course offered by | Year | URL                                                                                       |
|---------|--------------------------------|-------------------|------|-------------------------------------------------------------------------------------------|
| 1       | Ayurvedic Inheritance of India | IIT Madras        | 2013 | <a href="http://nptel.ac.in/courses/121106003/">http://nptel.ac.in/courses/121106003/</a> |
| 1       | Indian Knowledge System        | BMSCE             | 2026 | <a href="http://lms.bmsce.in">http://lms.bmsce.in</a>                                     |

**Course Outcomes (COs):**

|     |                                                                                                                                                                           |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Apply IKS concepts to differentiate knowledge systems.                                                                                                                    |
| CO2 | Analyse the contributions of traditional Indian knowledge to the humanities and sciences                                                                                  |
| CO3 | Relate traditional governance and public administration practices in India to contemporary global frameworks, including the United Nations Sustainable Development Goals. |

**CO-PO-PSO- Mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      | 2    |      |      |      |
| CO2 |     | 3   |     |     |     |     |     |     |     |      | 2    |      |      |      |
| CO3 |     |     |     |     |     | 2   |     |     |     |      | 2    |      |      |      |

**Assessment Plan for CIE:**

| Tool                       | Remarks | Marks     |
|----------------------------|---------|-----------|
| QUIZ                       | 5/6     | 50        |
| AAT/ EXPERIENTIAL LEARNING | --      | -         |
| Lab Component              | --      | --        |
| <b>Total</b>               |         | <b>50</b> |



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# **8<sup>th</sup>**

# **Semester**



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|                      |                              |                             |           |
|----------------------|------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>7/8</b>                   |                             |           |
| <b>Course Title:</b> | <b>Network Security</b>      |                             |           |
| <b>Course Code:</b>  | <b>23CS8PENES/23CS7PENES</b> | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                 | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Hours</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Computer and Network Security Concepts:</b> Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles , Attack Surfaces and Attack Trees, A Model for Network Security.                                                                                                                                                                                      | <b>8</b>     |
| <b>2</b>        | <b>User Authentication:</b> Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos, Remote User-Authentication Using Asymmetric Encryption, Federated Identity Management, Personal Identity Verification.                                                                                                                                                                                                        | <b>8</b>     |
| <b>3</b>        | <b>Network Access Control and Cloud Security:</b> Network Access Control Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control, Cloud Computing, Cloud Security Risks and Countermeasures, Data Protection in the Cloud, Cloud Security as a Service, Addressing Cloud Computing Security Concerns.<br><br><b>Transport-Level Security:</b> Web Security Considerations, Transport Layer Security, HTTPS 566, Secure Shell (SSH) 567. | <b>9</b>     |
| <b>4</b>        | <b>Wireless Network Security:</b> Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security.<br><b>Electronic Mail Security:</b> Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security, S/MIME, Pretty Good Privacy, DNSSEC, DNS-Based Authentication of Named Entities.                                                                                               | <b>9</b>     |
| <b>5</b>        | <b>IP Security:</b> IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Cryptographic Suites.<br><br><b>Intruders:</b> Intruders, Intrusion Detection, Password Management.                                                                                                                                                                                                         | <b>8</b>     |

**Prescribed Text Book:**

| <b>Sl. No.</b> | <b>Book Title</b>                                          | <b>Authors</b>    | <b>Edition</b>  | <b>Publisher</b> | <b>Year</b> |
|----------------|------------------------------------------------------------|-------------------|-----------------|------------------|-------------|
| 1              | Cryptography and network security Principles and Practices | William Stallings | 7 <sup>th</sup> | Pearson          | 2017        |



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**Reference Text Books:**

| Sl. No. | Book Title                                                | Authors                                       | Edition         | Publisher         | Year |
|---------|-----------------------------------------------------------|-----------------------------------------------|-----------------|-------------------|------|
| 1       | Network Security: PRIVATE Communication in a PUBLIC World | Charlie Kaufman, Radia Perlman, Mike Speciner | 2 <sup>nd</sup> | Pearson Education | 2002 |
| 2       | Cryptography and Network Security                         | Atul Kahate                                   | 3 <sup>rd</sup> | Tata McGraw-Hill  | 2017 |
| 3       | Cryptography and Network Security                         | Behrouz A. Forouzan, Debdeep Mukhopadhyay     | 2 <sup>nd</sup> | Tata McGraw- Hill | 2013 |

**E-Books:**

| Sl. No. | Book Title                                                 | Authors                       | Edition         | Publisher         | Year | URL                                                                                               |
|---------|------------------------------------------------------------|-------------------------------|-----------------|-------------------|------|---------------------------------------------------------------------------------------------------|
| 1       | Cryptography and Network Security: Principles and Practice | William Stallings             | 3 <sup>rd</sup> | Pearson Education | 2007 | <a href="http://williamstallings.com/Crypto3e.html">http://williamstallings.com/Crypto3e.html</a> |
| 2       | Handbook of Applied Cryptography                           | Menez, van Oorschot, Vanstone | 1 <sup>st</sup> | CRC Press         | 2001 | <a href="http://www.cacr.math.uwaterloo.ca/hac/">http://www.cacr.math.uwaterloo.ca/hac/</a>       |

**MOOC Courses:**

| Sl. No. | Course name                       | Course Offered By | Year | URL                                                                                         |
|---------|-----------------------------------|-------------------|------|---------------------------------------------------------------------------------------------|
| 1       | Cryptography and Network Security | NPTEL             | 2017 | <a href="http://nptel.ac.in/courses/106105031/">http://nptel.ac.in/courses/106105031/</a>   |
| 2       | Cryptography I                    | Coursera          | 2019 | <a href="https://www.coursera.org/course/crypto">https://www.coursera.org/course/crypto</a> |

**Course Outcomes (COs):**

|            |                                                                                                                                                                        |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply secure communication protocols to protect sensitive data transmission over public networks                                                                       |
| <b>CO2</b> | Analyze complex network security challenges, identify potential vulnerabilities, and formulate effective strategies for mitigating security risks                      |
| <b>CO3</b> | Design a comprehensive network security plan for a small to medium-sized organization, ensuring the confidentiality, integrity, and availability of data and resources |



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**CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3     |
|------------|----------|----------|----------|-----|-----|-----|-----|-----|-----|------|------|------|------|----------|
| <b>CO1</b> | <b>3</b> |          |          |     |     |     |     |     |     |      |      |      |      | <b>3</b> |
| <b>CO2</b> |          | <b>3</b> |          |     |     |     |     |     |     |      |      |      |      |          |
| <b>CO3</b> |          |          | <b>3</b> |     |     |     |     |     |     |      |      |      |      |          |

**Assessment Tool for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>     | <b>Marks</b> |
|----------------------------------------|--------------------|--------------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b>    |
| <b>Quiz</b>                            | <b>Two</b>         | <b>10</b>    |
| <b>Lab Component</b>                   | ---                | ---          |
| <b>Alternate Assessment Tool (AAT)</b> | ---                | ---          |
| <b>Total</b>                           |                    | <b>50</b>    |



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|                      |                                         |                             |           |
|----------------------|-----------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>7/8</b>                              |                             |           |
| <b>Course Title:</b> | <b>Neural Network and Deep Learning</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS8PENDL/23CS7PENDL</b>            | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                            | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>Hours</b> |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>An Introduction to Neural Networks:</b> Models of a Neuron, Feedback, Network Architectures, Rosenblatt's Perceptron: The Perceptron Convergence Theorem, Relation between Perceptron and Bayes Classifier for a Gaussian Environment, The Least-Mean-Square Algorithm: Statistical LMS Learning Theory for Small Learning Rate Parameter, Learning Rate Annealing Schedules, | <b>8</b>     |
| <b>2</b>        | <b>Multilayer Perceptron:</b> Introduction, Batch Learning and on-line Learning, The Back-Propagation Algorithm, The Hessian and its Role in On-Line Learning, Generalization, Approximation of Functions, Cross-Validation, Complexity Regularization and Network Pruning, Supervised Learning viewed as an Optimization, Non-Linear Filtering                                  | <b>9</b>     |
| <b>3</b>        | <b>Deep Learning: Introduction,</b> Parameter Norm Penalties - L2 Parameter Regularization, Dataset Augmentation, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Dropout.                                                                                                                         | <b>9</b>     |
| <b>4</b>        | <b>Convolution neural networks:</b> The Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms                                                                                                                                      | <b>8</b>     |
| <b>5</b>        | <b>Sequence Modelling:</b> Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks                                                                                                                                                       | <b>8</b>     |

**Prescribed Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                     | <b>Authors</b>                                 | <b>Edition</b>  | <b>Publisher</b>      | <b>Year</b> |
|----------------|---------------------------------------|------------------------------------------------|-----------------|-----------------------|-------------|
| 1              | Neural Networks and Learning Machines | Simon Haykin                                   | 3 <sup>rd</sup> | Pearson Prentice Hall | 2010        |
| 2              | Deep Learning: An MIT Press Book      | Ian Goodfellow, Yoshua Bengio, Aaron Courville | 1 <sup>st</sup> | The MIT Press         | 2016        |



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**Reference Text Books:**

| Sl. No. | Book Title                         | Authors          | Edition         | Publisher                         | Year |
|---------|------------------------------------|------------------|-----------------|-----------------------------------|------|
| 1       | Neural Networks and Deep Learning  | Charu C Aggarwal | 1 <sup>st</sup> | Springer International Publishing | 2018 |
| 2       | An introduction to neural networks | Kevin Gurney     | 1 <sup>st</sup> | UCL Press                         | 2004 |

**E-Books:**

| Sl. No. | Book Title                                    | Authors             | Edition         | Publisher | Year | URL                                                                                                                           |
|---------|-----------------------------------------------|---------------------|-----------------|-----------|------|-------------------------------------------------------------------------------------------------------------------------------|
| 1       | Deep Learning in Neural Networks: An Overview | Juergen Schmidhuber | 1 <sup>st</sup> | arXiv.org | 2014 | <a href="https://www.e-booksdirectory.com/detail.php?ebook=10110">https://www.e-booksdirectory.com/detail.php?ebook=10110</a> |
| 2       | Artificial Neural Network                     | B. Mehlig           | 1 <sup>st</sup> | arXiv.org | 2019 | <a href="https://www.e-booksdirectory.com/detail.php?ebook=12212">https://www.e-booksdirectory.com/detail.php?ebook=12212</a> |

**MOOC Courses:**

| Sl. No. | Course name                       | Course Offered By | Year | URL                                                                                                                                     |
|---------|-----------------------------------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Neural Networks and Deep Learning | Coursera          | 2023 | <a href="https://www.coursera.org/learn/neural-networks-deep-learning">https://www.coursera.org/learn/neural-networks-deep-learning</a> |
| 2       | Deep learning                     | NPTEL             | 2023 | <a href="https://onlinecourses.nptel.ac.in/non23_ee131/preview">https://onlinecourses.nptel.ac.in/non23_ee131/preview</a>               |

**Course Outcomes (COs):**

|     |                                                                             |
|-----|-----------------------------------------------------------------------------|
| CO1 | Apply the concepts of Neural Networks and Deep Learning for problem solving |
| CO2 | Analyze various learning algorithms and its applications                    |
| CO3 | Develop deep learning models to solve real world problems                   |

**BMS COLLEGE OF ENGINEERING, BANGALORE-19****(Autonomous College under VTU Belagavi)****DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****CO-PO-PSO mapping:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2 |     | 3   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3 |     |     | 2   | 2   |     |     |     | 2   | 2   |      | 2    |      |      |      |

**Assessment Plan for CIE:**

| Tool                            | Remarks     | Marks |
|---------------------------------|-------------|-------|
| Internals                       | Best 2 of 3 | 40    |
| Quiz                            | Two         | 10    |
| Lab component                   | --          | --    |
| Alternate Assessment Tool (AAT) | --          | --    |
| Total                           |             | 50    |

**AAT Plan**

Students should choose recently (Year 2023/2024/2025) published ONE paper in a journal from reputed publishers Springer/ACM/Elsevier/IEEE Access/MDPI etc. Students should select research papers for which datasets are available for download. No Conference papers are allowed.

Implementation: Each student in the team (2 to 4) should show the implementation of the problem selected in the paper for "one Multi layer neural Network (NN) and one Deep learning (DL) architecture" for the SAME dataset. That is, if there are four students in a team then totally eight models will get implemented (One member X Two models x 4=Eight models). Each student should prepare the ARCHITECTURE diagram of the model implemented with MATHEMATICAL Equations.

Note: Refrain from using AI tool to Generate Diagrams or Equations. Each student should know in depth of their implemented NN and DL model architecture with mathematical equations related to model and implementation.

Evaluation Metrics for the models implemented should be appropriate. For example, if it is a Classification problem then Confusion Matrix, Classification report and AUC-ROC curve are the metrics and so on for regression problems.

**Student Project group Plan of Activities:**

Following are the activities week-wise to be carried out by students during project work.

| Sl. No | Week        | Activity                                                                             | No. of hours for Self-learning |
|--------|-------------|--------------------------------------------------------------------------------------|--------------------------------|
| 1      | 1st and 2nd | Choosing the problem domain and defining objectives for NN/DL-based solution         | –                              |
| 2      | 3rd and 4th | Literature survey on similar problems and neural network/deep learning architectures | 3                              |
| 3      | 5th and 6th | Dataset identification and collection, dataset exploration and understanding (EDA)   | 3                              |



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|   |               |                                                                                      |   |
|---|---------------|--------------------------------------------------------------------------------------|---|
| 4 | 7th and 8th   | Data preprocessing and feature preparation for neural networks                       | 2 |
| 5 | 9th and 10th  | Implementation of different neural network and deep learning architectures           | 2 |
| 6 | 11th and 12th | Performance evaluation using suitable metrics and comparative analysis of all models | 2 |
| 7 | 13th          | Conclusion, best model selection, and result interpretation                          | 3 |
| 8 | 14th          | Report preparation and presentation                                                  | 6 |

#### Rubrics used for AAT evaluation:

| Criteria                                                    | Exemplary                                                                                                            | Proficient                                                                              | Partially Proficient                                                              | Points                   |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------|
| Problem Definition & Dataset Selection                      | (2.5–2)<br>Clearly defined, relevant problem with well-stated objectives; dataset is appropriate for NN/DL models    | (1.5–1)<br>Problem defined with minor gaps; dataset appropriate but explanation limited | (0.5–0)<br>No proper problem definition; dataset partially relevant               | $\frac{\text{---}}{2.5}$ |
| Architecture Selection (minimum 3 models)                   | (2.5–2)<br>NN/DL architectures (e.g., MLP, CNN, RNN/LSTM, Transformer) well-chosen and clearly justified             | (1.5–1)<br>Suitable architectures selected with basic justification                     | (0.5–0)<br>Architectures chosen without justification                             | $\frac{\text{---}}{2.5}$ |
| Comparative Analysis, Conclusion & Best Model Justification | (2.5–2)<br>Best architecture identified with strong experimental evidence and metric-based comparison                | (1.5–1)<br>Best model identified with some reasoning                                    | (0.5–0)<br>Incorrect or weak conclusion                                           | $\frac{\text{---}}{2.5}$ |
| Presentation and Report                                     | (2.5–2)<br>Presentation is clear and effective; report is well-structured and adheres to technical writing standards | (1.5–1)<br>Clear communication with minor syntax or formatting issues                   | (0.5–0)<br>Unclear communication; ineffective writing with multiple syntax errors | $\frac{\text{---}}{2.5}$ |
| Total                                                       |                                                                                                                      |                                                                                         |                                                                                   | $\frac{\text{---}}{10}$  |



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**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

|                      |                                        |                             |           |
|----------------------|----------------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>7/8</b>                             |                             |           |
| <b>Course Title:</b> | <b>Virtual &amp; Augmented Reality</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS8PEVAR/23CS7PEVAR</b>           | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                           | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                             | <b>Hours</b> |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Introduction to Augmented Reality:</b> History of AR, AR Scenarios, the future of AR, Applications of AR. Calibration and Registration: Transformations, Coordinate Systems                                            | <b>8</b>     |
| <b>2</b>        | <b>Pose Estimation and Tracking:</b> Pose Estimation; Pose Tracking in AR, Mobile Sensor-Based Tracking, Optical Tracking, Hybrid Tracking, Marker-Based Tracking and AR, Diminished Reality, Marker-less Tracking and AR | <b>9</b>     |
| <b>3</b>        | <b>Computer Vision for AR:</b> Image Processing, Computer Vision-Definition and Scope, Object Detection and Tracking, Spatial Mapping, 3D Reconstruction for outdoor Tracking, OCR and Text Recognition for AR            | <b>9</b>     |
| <b>4</b>        | Introduction to Virtual Reality, Interface to the Virtual World- Input, Output, Interaction.                                                                                                                              | <b>8</b>     |
| <b>5</b>        | Introduction to Unity, Game Objects, Models, Materials, and Textures, Terrain, Environments, Lights and Camera, Scripting.                                                                                                | <b>8</b>     |

**Prescribed Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                                                | <b>Authors</b>                  | <b>Edition</b>  | <b>Publisher</b>           | <b>Year</b> |
|----------------|------------------------------------------------------------------|---------------------------------|-----------------|----------------------------|-------------|
| 1              | Augmented Reality: Theory, Design and Development                | Chetankumar G Shetty            | 1 <sup>st</sup> | McGraw Hill Publications   | 2020        |
| 2              | Understanding Virtual Reality: Interface, Application and Design | William R Sherman, Alan B Craig | 1 <sup>st</sup> | Morgan Kaufmann Publishers | 2002        |
| 3              | Teach Yourself Unity 2018 Game Development in 24 Hours           | Mike Gieg, Sams                 | 1 <sup>st</sup> | Pearson                    | 2018        |

**Reference Text Books:**

| <b>Sl. No.</b> | <b>Book Title</b>                | <b>Authors</b>                        | <b>Edition</b>  | <b>Publisher</b> | <b>Year</b> |
|----------------|----------------------------------|---------------------------------------|-----------------|------------------|-------------|
| 1              | Augmented Reality for Developers | Krystian Babilinski, Jonathan Linowes | 1 <sup>st</sup> | Packt            | 2017        |
| 2              | Designing the User Interface     | B. Shneiderman                        | 4 <sup>th</sup> | Addison Wesley   | 2014        |



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**E-Book:**

| Sl. No. | Book Title        | Authors          | Edition         | Publisher  | Year | URL                                                                                                                                                                                         |
|---------|-------------------|------------------|-----------------|------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Augmented Reality | Jose Maria Ariso | 1 <sup>st</sup> | De Gruyter | 2017 | <a href="https://library.oapen.org/bitstream/id/f922c42d-ad74-4af1-953c-02c7518f37a7/628401.pdf">https://library.oapen.org/bitstream/id/f922c42d-ad74-4af1-953c-02c7518f37a7/628401.pdf</a> |

**MOOC Courses:**

| Sl. No. | Course name                                               | Course offered by | Year | URL                                                                                                                                                                                             |
|---------|-----------------------------------------------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Virtual reality                                           | NPTEL             | 2014 | <a href="https://nptel.ac.in/courses/106106138">https://nptel.ac.in/courses/106106138</a>                                                                                                       |
| 2       | Build 15 Augmented Reality (AR) apps with Unity & Vuforia | Udemy             | 2022 | <a href="https://www.udemy.com/course/develop-augmented-reality-book-ar-business-card-with-unity/">https://www.udemy.com/course/develop-augmented-reality-book-ar-business-card-with-unity/</a> |

**Course Outcomes (COs):**

|            |                                                                                        |
|------------|----------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply AR concepts to build / transform 2D/3D models                                    |
| <b>CO2</b> | Analyse the different calibration, transformation and tracking using augmented reality |
| <b>CO3</b> | Design user event and interactive events using Unity                                   |

**CO-PO-PSO Mapping:**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | 2   |     |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |     | 2   |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> |     |     | 3   | 2   | 3   |     |     | 2   | 2   |      | 2    |      |      |      |



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**Assessment Plan for CIE:**

| Tool                            | Remarks    | Marks     |
|---------------------------------|------------|-----------|
| Internals                       | Best 2of 3 | 40        |
| Quiz                            | Two        | 10        |
| Lab component                   | -          | --        |
| Alternate Assessment Tool (AAT) | -          | --        |
| <b>Total</b>                    |            | <b>50</b> |

**AAT Plan:**

- The alternate assessment consists of a presentation worth 40 marks based on the solution derived from studying a selected topic.
- Students must work in teams of 3–4 members to complete the study.
- The chosen topic should focus on current research trends, applications, or emerging technologies related to Augmented Reality (AR) and Virtual Reality (VR).
- Although the work is done in teams, each student must deliver an individual presentation on the selected topic.
- A written report following the IEEE paper format must also be prepared and submitted as documentation of the work.

**Self-Learning Activity 2:**

Students are supposed to do demonstrations and make a report on AR Development using any one platform for the application considered.

**Rubrics used for AAT evaluation:**

| Criteria                              | Excellent                                                                                                                                                                                                             | Good                                                                                                                                                | Unsatisfactory                                                                                                                                                      | Points   |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Literature survey / Background Work   | Clearly summarized the ideas of sources by a thorough review of Exhaustive/ Literature Survey (10 Marks)                                                                                                              | Reviewed credible/quality literatures(6-9 Marks)                                                                                                    | Insufficient background work. (1-5Marks)                                                                                                                            | ___ / 10 |
| AR Application Demonstration & Report | Demonstration is fully functional with smooth tracking, clear interaction, and effective use of AR platform features; report is well-structured with detailed methodology, screenshots, results, and proper technical | Demonstration works with minor issues in tracking or interaction; report covers main aspects but lacks depth, clarity, or detailed analysis in some | Demonstration is incomplete/non-functional or shows major errors; report is poorly organized with minimal explanation and insufficient documentation. (0 - 7 Marks) | ___ / 20 |



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|               |                                                                        |                                                                        |                                                                 |         |
|---------------|------------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------|---------|
|               | explanation. (14-20marks)                                              | sections.(8-13 marks)                                                  |                                                                 |         |
| Documentation | Well written, appropriate content and neatly organized paper (5 Marks) | Well written paper (3-4 Marks)                                         | Follows format but not included enough information (1-2 Marks ) | ___ / 5 |
| Presentation  | Able to make effective presentation with good visual aids(5 Marks).    | Able to make effective presentation using powerpoint slides(3-4 Marks) | Unclear communication(1-2Marks)                                 | ___/5   |
| Total         |                                                                        |                                                                        |                                                                 | ___/40  |



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|                      |                                   |                             |           |
|----------------------|-----------------------------------|-----------------------------|-----------|
| <b>Semester:</b>     | <b>7/8</b>                        |                             |           |
| <b>Course Title:</b> | <b>High Performance Computing</b> |                             |           |
| <b>Course Code:</b>  | <b>23CS8PEHPC/23CS7PEHPC</b>      | <b>Total Contact Hours:</b> | <b>42</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                      | <b>Total Credits:</b>       | <b>3</b>  |

| <b>Unit No.</b> | <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Hours</b> |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>1</b>        | <b>Introduction to Parallel Computing:</b> Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques | <b>8</b>     |
| <b>2</b>        | <b>Principles of Parallel Algorithm design:</b> Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for containing Interaction Overheads, Parallel Algorithms Models, Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, the Effect of Granularity on Performance                                                           | <b>9</b>     |
| <b>3</b>        | <b>Programming Using the Message Passing Paradigm:</b> Principles of Message Passing Programming, Building Blocks, MPI, Topologies and Embedding, Overlapping Communication with computation, Collective Communication and computation operations, Groups and Communicators                                                                                                                                                                                                           | <b>8</b>     |
| <b>4</b>        | <b>Programming Shared Address Space Platforms:</b> Thread Basics, The POSIX Thread API, Thread Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, Tips for Designing Asynchronous Programs, OpenMP: a Standard for Directive Based Parallel Programming                                                                                                  | <b>9</b>     |
| <b>5</b>        | <b>GPU Programming using CUDA:</b> Heterogeneous Computing, Hello World from GPU, Introducing the CUDA Programming Model, Organizing Parallel Threads, Managing Devices, CUDA Memory Model                                                                                                                                                                                                                                                                                            | <b>8</b>     |

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| Sl. No. | Book Title                                                          | Authors                                                 | Edition         | Publisher                   | Year |
|---------|---------------------------------------------------------------------|---------------------------------------------------------|-----------------|-----------------------------|------|
| 1       | Introduction to Parallel Computing                                  | Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar | 2 <sup>nd</sup> | Pearson Education           | 2013 |
| 2       | Professional CUDA C Programming                                     | John Cheng, Max Grossman, Ty McKercher                  | 1 <sup>st</sup> | Wiley                       | 2014 |
| 3       | CUDA by Example, An Introduction to General Purpose GPU Programming | Jason Sanders, Edward Kandrot                           | 1 <sup>st</sup> | Addison-Wesley Professional | 2010 |

**Reference Text Book:**

| Sl. No. | Book Title                                                                | Authors                   | Edition         | Publisher   | Year |
|---------|---------------------------------------------------------------------------|---------------------------|-----------------|-------------|------|
| 1       | Advanced Computer Architecture: Parallelism, Scalability, Programmability | Kai Hwang; Naresh Jotwani | 2 <sup>nd</sup> | McGraw-Hill | 2010 |

**E-Book:**

| Sl. No. | Book Title                 | Authors                       | Edition         | Publisher    | Year | URL                                                                                                                                       |
|---------|----------------------------|-------------------------------|-----------------|--------------|------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | High Performance Computing | Charles Severance, Kevin Dowd | 1 <sup>st</sup> | OpenStax CNX | 2009 | <a href="https://archive.org/details/cnx-org-col11136/page/n1/mode/2up">https://archive.org/details/cnx-org-col11136/page/n1/mode/2up</a> |

**MOOC Courses:**

| Sl. No. | Course name                                             | Course offered by | Year | URL                                                                                                                                                         |
|---------|---------------------------------------------------------|-------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Introduction to High performance and parallel computing | Coursera          | 2022 | <a href="https://www.coursera.org/learn/introduction-high-performance-computing">https://www.coursera.org/learn/introduction-high-performance-computing</a> |
| 2       | High performance computing for scientists and engineers | NPTEL             | 2020 | <a href="https://archive.nptel.ac.in/courses/112/105/112105293/">https://archive.nptel.ac.in/courses/112/105/112105293/</a>                                 |



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**Course Outcomes (COs):**

|            |                                                                                                                 |
|------------|-----------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply the fundamentals of high-performance computing concepts to understand the performance of HPC applications |
| <b>CO2</b> | Analyze the impact of architecture and system configurations on HPC                                             |
| <b>CO3</b> | Demonstrate high performance computing concepts using various parallel programming paradigms                    |

**CO-PO-PSO Mapping:**

|            | PO1      | PO2      | PO3      | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------|----------|----------|----------|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b> | <b>3</b> |          |          |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO2</b> |          | <b>3</b> |          |     |     |     |     |     |     |      |      |      |      |      |
| <b>CO3</b> |          |          | <b>3</b> |     |     |     |     |     |     |      |      |      |      |      |

**Assessment Plan for CIE:**

| <b>Tool</b>                            | <b>Remarks</b>     | <b>Marks</b> |
|----------------------------------------|--------------------|--------------|
| <b>Internals</b>                       | <b>Best 2 of 3</b> | <b>40</b>    |
| <b>Quiz</b>                            | <b>Two</b>         | <b>10</b>    |
| <b>Lab component</b>                   | --                 | --           |
| <b>Alternate Assessment Tool (AAT)</b> | --                 | --           |
| <b>Total</b>                           |                    | <b>50</b>    |



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|                      |                                                |                                 |           |
|----------------------|------------------------------------------------|---------------------------------|-----------|
| <b>Semester:</b>     | <b>7/8</b>                                     |                                 |           |
| <b>Course Title:</b> | <b>MOOC/<br/>NPTEL Courses</b>                 |                                 |           |
| <b>Course Code:</b>  | <b>25MC8OEXXX<br/>*MOOC/<br/>NPTEL Courses</b> | <b>Total Contact<br/>Hours:</b> | <b>--</b> |
| <b>L-T-P:</b>        | <b>3-0-0</b>                                   | <b>Total Credits:</b>           | <b>3</b>  |

**Guidelines:**

- Students are eligible to enroll in AICTE-approved 12-week NPTEL courses with proctored examinations.
- A student can enroll and complete the course during 3<sup>rd</sup> or 4<sup>th</sup> year of his/her study. However, he/she may claim only one NPTEL course per semester for credit transfer as per the scheme.
- A 12-week NPTEL course will be equivalent to 3 institute credits at institute level.
- Students must obtain prior approval from the department's NPTEL course Coordinator, and the Head of the Department.
- Strict monitoring of the student progress in the registered NPTEL course will be done by the student's proctor, department's NPTEL course Coordinator and the Head of the Department.

**Assessment:**

- Students must appear for the NPTEL proctored final examination and the Grades obtained will be mapped to the institute's grading system as follows:

| <b>NPTEL Score</b> | <b>Institute Grade</b> | <b>Grade Point</b>   |
|--------------------|------------------------|----------------------|
| <b>90—100</b>      | <b>O</b>               | <b>10</b>            |
| <b>80—89</b>       | <b>A+</b>              | <b>9</b>             |
| <b>70—79</b>       | <b>A</b>               | <b>8</b>             |
| <b>60—69</b>       | <b>B+</b>              | <b>7</b>             |
| <b>50—59</b>       | <b>B</b>               | <b>6</b>             |
| <b>45—49</b>       | <b>C</b>               | <b>5</b>             |
| <b>40-44</b>       | <b>D</b>               | <b>4</b>             |
| <b>Below 40</b>    | <b>F (Fail)</b>        | <b>0 (No Credit)</b> |

- If a student scores below 40%, the course shall be marked as F (Fail), and no credits will be transferred.
- The student must then take the NPTEL course in the next academic term as per institute academic policies.
- At the end of 8<sup>th</sup> semester, if a student fails to clear the NPTEL course, special provision may be provided as the NPTEL supplementary exam guideline which states that CIE of NPTEL to be considered and SEE to be conducted by the institution based on the NPTEL curriculum and assignments of the respective course.



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|                      |                   |                       |          |
|----------------------|-------------------|-----------------------|----------|
| <b>Semester:</b>     | <b>8</b>          |                       |          |
| <b>Course Title:</b> | <b>Internship</b> |                       |          |
| <b>Course Code:</b>  | <b>23CS8SRINT</b> |                       |          |
| <b>L-T-P:</b>        | <b>0-0-6</b>      | <b>Total Credits:</b> | <b>6</b> |

**Guidelines:**

1. Internship must be carried out in any IT organization or a premier Institute or a Research Lab or a Government organization related to Computer Science and Engineering.
2. The internship must be carried out by each student for at least four months.
3. Non-technical Internships are strictly not allowed.
4. The work carried out during the Internship will be evaluated by the faculty based on three reviews during the semester.

**Course Outcomes (COs):**

|            |                                                                                                                                                 |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Apply domain knowledge and relevant literature to understand and address the requirements of the internship problem.                            |
| <b>CO2</b> | Analyse the identified problem and develop/implement appropriate solutions using suitable techniques, resources, and contemporary tools.        |
| <b>CO3</b> | Work independently or collaboratively in multidisciplinary environments to accomplish assigned tasks and achieve intended outcomes.             |
| <b>CO4</b> | Exhibit integrity, professional ethics, and responsible behaviour during the internship and in the preparation and execution of technical work. |
| <b>CO5</b> | Communicate effectively with guides and stakeholders through formal and informal interactions, presentations, and technical documentation.      |

**CO-PO-PSO Mapping:**

|            | PO1      | PO2 | PO3      | PO4      | PO5      | PO6 | PO7      | PO8      | PO9      | PO10     | PO11     | PSO1     | PSO2     | PSO3     |
|------------|----------|-----|----------|----------|----------|-----|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>CO1</b> | <b>3</b> |     |          | <b>2</b> |          |     |          |          |          |          | <b>2</b> |          |          |          |
| <b>CO2</b> |          |     | <b>3</b> |          | <b>3</b> |     |          |          |          | <b>2</b> |          | <b>2</b> | <b>2</b> | <b>2</b> |
| <b>CO3</b> |          |     |          |          |          |     |          | <b>3</b> |          |          | <b>2</b> |          |          |          |
| <b>CO4</b> |          |     |          |          |          |     | <b>3</b> |          |          |          |          |          |          |          |
| <b>CO5</b> |          |     |          |          |          |     |          |          | <b>3</b> |          |          |          |          |          |

**Assessment Plan for CIE:**

Every student will be assigned a guide, who will assess their performance during the Internship phases. Three reviews will be conducted during the assessment.

Evaluation criteria for each of the reviews:



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**Review–1: Verification and Acceptance of Internship Work**

Review–1 shall be conducted at the beginning of the internship/project to verify whether the proposed internship work is relevant, technically feasible, and aligned with the programme outcomes. The internship work shall be **accepted only after satisfactory verification by the review committee/faculty guide**.

1. Clear identification of the problem/task undertaken during the internship
2. Specific, measurable and achievable objectives
3. Review of existing methods/systems and relevance to the proposed internship work
4. Clear methodology/work plan for achieving the stated objectives
5. Clearly defined scope, expected deliverables and outcomes
6. Work should be relevant to the assigned industry/research domain
7. Availability of resources, tools, data and facilities required to complete the work

**Review–2: Progress Review- 50 Marks**

Review–2 shall be conducted to assess the progress of the approved internship work. The student shall demonstrate the work completed after Review–1, implementation/progress made towards the approved objectives, supporting evidence, interim deliverables, and learning gained during the internship.

Review–2 should assess the **progress made after Review–1**, rather than reassessing only the proposal.

1. The student shall present the approved problem statement, objectives and methodology briefly and explain the progress made since Review–1.
2. The student shall maintain and submit the internship daily report/diary covering the activities performed during the internship period.
3. The student shall present the literature survey/relevant background supporting the internship work.
4. The student shall demonstrate the implementation/progress of the assigned work, including theoretical analysis, experimentation, development, fabrication, testing or other relevant activities, as applicable.
5. The student shall provide evidence of progress through working models, software demonstrations, experimental results, screenshots, test results, observations, charts or other relevant evidence.
6. The student shall present the interim deliverables and outcomes achieved against the approved objectives.
7. The student shall explain the technical challenges encountered and the approaches adopted to address them.
8. The student shall demonstrate appropriate use of tools, technologies, resources and technical methods relevant to the internship.
9. The student shall deliver a progress presentation before the review committee.



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10. The review committee shall assess the student's technical understanding, progress, documentation, implementation and communication skills.
11. Any significant deviation from the work approved during Review–1 shall be justified and documented.
12. The feedback and recommendations given during Review–2 shall be incorporated into the remaining internship work and final submission.

**Review–3: Final Internship Evaluation — 50 Marks**

Review–3 shall be conducted as the final evaluation of the internship work. The student shall demonstrate the completion of the approved internship objectives, quality of implementation, final deliverables, outcomes, documentation, technical learning and ability to communicate and defend the work.

1. The student shall present the complete internship work undertaken based on the work approved during Review–1 and evaluated during Review–2.
2. The student shall submit the complete internship daily report/diary covering the internship period.
3. The student shall demonstrate the final implementation/ product/ model/ software/system/ experimental work, as applicable.
4. The student shall present the methodology adopted, implementation carried out, testing/validation performed and results obtained.
5. The student shall demonstrate achievement of the approved objectives using appropriate evidence.
6. The student shall present the final deliverables and measurable outcomes of the internship.
7. The student shall discuss the technical challenges, solutions adopted, limitations and possible future improvements.
8. The student shall demonstrate the effective use of contemporary tools, technologies, resources and techniques, wherever applicable.
9. The student shall deliver a final technical presentation before the review committee.
10. The student shall attend a question-and-answer/viva voce session and demonstrate adequate understanding of the problem, methodology, implementation, tools, results and outcomes.
11. The final evaluation shall consider the quality, completeness, originality/relevance and technical contribution of the internship work.
12. The student shall incorporate the recommendations received during Review–2 in the final internship work and report.
13. The final internship report shall be submitted in the prescribed format along with relevant supporting documents/evidence.



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Review-2 Rubrics – 50 Marks

| <b>Performance Indicator</b>                                | <b>Max. Marks</b> | <b>HIGH</b>                                                                                                                                                                                                                                       | <b>MODERATE</b>                                                                                                                                                                        | <b>LOW</b>                                                                                                                           |
|-------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>Industry/Research Internship Daily Report</b>            | <b>10</b>         | Diary is exceptionally detailed, well-organized and regularly maintained. It clearly documents internship activities, tasks performed and relevant evidence such as screenshots, charts, observations or other supporting material. <b>(7–10)</b> | Diary is adequately maintained but lacks consistency or some details. Documentation of activities is present but partially incomplete and supporting evidence is limited. <b>(4–6)</b> | Diary contains significant gaps, is poorly organized or lacks relevant documentation/evidence of internship activities. <b>(0–3)</b> |
| <b>Literature Survey &amp; Relevance to Present Context</b> | <b>5</b>          | Extensive literature survey with good understanding of existing systems/methods and their relevance to the internship work. <b>(4–5)</b>                                                                                                          | Moderate literature survey with basic understanding of existing systems/methods. <b>(2–3)</b>                                                                                          | Inadequate literature survey with insufficient understanding of existing systems/methods. <b>(0–1)</b>                               |
| <b>Problem Identification &amp; Objectives</b>              | <b>5</b>          | Problem is clearly defined and objectives are specific, measurable, relevant and aligned with the internship work. <b>(4–5)</b>                                                                                                                   | Problem and objectives are reasonably defined but lack specificity or complete alignment. <b>(2–3)</b>                                                                                 | Problem is unclear and objectives are vague, incomplete or poorly aligned. <b>(0–1)</b>                                              |



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|                                                            |           |                                                                                                                                                                                                                                                                  |                                                                                                                                        |                                                                                                                       |
|------------------------------------------------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| <b>Implementation / Progress of Work</b>                   | <b>15</b> | Planned methodology is systematically implemented. Significant progress is demonstrated through theoretical analysis, experimentation, development, fabrication, testing or other appropriate activities. Technical decisions are well justified. <b>(11–15)</b> | Moderate progress is demonstrated. Methodology is partially implemented, with some technical gaps or limited validation. <b>(6–10)</b> | Limited progress is demonstrated. Objectives are inadequately implemented or planning/execution is poor. <b>(0–5)</b> |
| <b>Interim Deliverables &amp; Outcomes</b>                 | <b>10</b> | Planned deliverables are substantially completed and demonstrate good technical quality and meaningful progress toward expected outcomes. <b>(7–10)</b>                                                                                                          | Deliverables are partially completed but have limited quality, functionality or impact. <b>(4–6)</b>                                   | Major deliverables are incomplete or there is little measurable progress/outcome. <b>(0–3)</b>                        |
| <b>Progress Presentation &amp; Technical Communication</b> | <b>5</b>  | Presentation is technically appropriate, well organized and clearly delivered. Student effectively explains work completed,                                                                                                                                      | Content is appropriate but delivery, organization or explanation has some limitations. <b>(2–3)</b>                                    | Content is inappropriate/incomplete and presentation is poorly delivered. <b>(0–1)</b>                                |



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|              |           |                                       |  |  |
|--------------|-----------|---------------------------------------|--|--|
|              |           | progress and challenges. <b>(4–5)</b> |  |  |
| <b>Total</b> | <b>50</b> |                                       |  |  |

**Review-3 Rubrics: 50 Marks**

| <b>Performance Indicator</b>                     | <b>Max. Marks</b> | <b>HIGH</b>                                                                                                                                                                                | <b>MODERATE</b>                                                                                                                 | <b>LOW</b>                                                                                                        |
|--------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| <b>Industry/Research Internship Daily Report</b> | <b>10</b>         | Diary is comprehensive, consistently maintained and provides clear evidence of the complete internship experience, tasks, learning and outcomes. <b>(7–10)</b>                             | Diary is adequately maintained but contains some gaps or inconsistencies in documentation/evidence. <b>(4–6)</b>                | Diary is incomplete, poorly organized and lacks adequate evidence of internship activities. <b>(0–3)</b>          |
| <b>Final Deliverables &amp; Outcomes</b>         | <b>15</b>         | Final deliverables are complete, technically sound and exceed expectations. Outcomes demonstrate significant value, functionality and achievement of the stated objectives. <b>(11–15)</b> | Final deliverables are substantially completed but have limitations in quality, functionality or impact. <b>(6–10)</b>          | Major deliverables are incomplete, technically inadequate or do not demonstrate measurable outcomes. <b>(0–5)</b> |
| <b>Implementation / Technical Work</b>           | <b>10</b>         | Implementation is systematic and technically sound. Appropriate methods, tools and resources are used, with adequate testing/validation and justification of                               | Implementation is satisfactory but has limitations in methodology, testing, validation or technical justification. <b>(4–6)</b> | Implementation is inadequate, poorly planned or insufficiently validated. <b>(0–3)</b>                            |



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|                                                      |           |                                                                                                                                                                                                |                                                                                                            |                                                                                                                            |
|------------------------------------------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
|                                                      |           | technical decisions.<br><b>(7–10)</b>                                                                                                                                                          |                                                                                                            |                                                                                                                            |
| <b>Final Presentation &amp; Communication Skills</b> | <b>5</b>  | Presentation is well structured, technically appropriate and confidently delivered. Student communicates the problem, methodology, implementation and outcomes effectively. <b>(4–5)</b>       | Presentation is appropriate but delivery or technical explanation has some limitations. <b>(2–3)</b>       | Presentation is incomplete/inappropriate and poorly delivered. <b>(0–1)</b>                                                |
| <b>Question– Answer / Viva Voce</b>                  | <b>10</b> | Demonstrates excellent understanding of the internship work, methodology, tools, results and limitations; answers questions accurately with appropriate technical justification. <b>(7–10)</b> | Demonstrates reasonable understanding but answers are partially correct or require prompting. <b>(4–6)</b> | Demonstrates inadequate understanding of the work and is unable to satisfactorily answer technical questions. <b>(0–3)</b> |
| <b>Total</b>                                         | <b>50</b> |                                                                                                                                                                                                |                                                                                                            |                                                                                                                            |

Note: The Internship will be evaluated for 100 Marks